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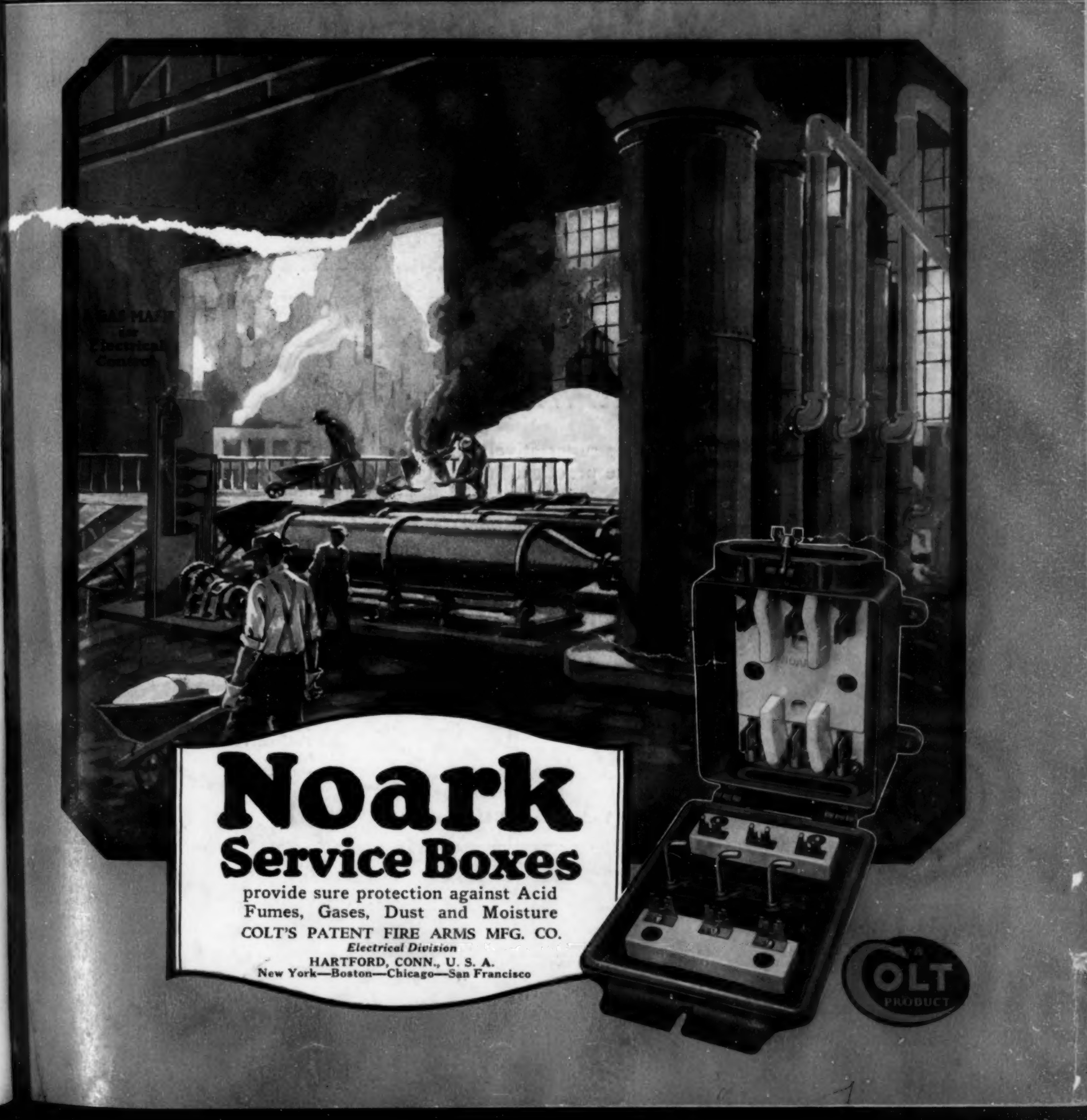

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CHEMICAL & METALLURGICAL ENGINEERING

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Contents, February, 1928

Editorials 73

Applying Mass Production Methods in a Pharmaceutical Plant 79
By Theodore R. Olive.

Five Years' Progress in Carbon Electrode Technology 84
By C. L. Mantell.

Mullite Refractories Extend Field of High-Temperature Operations 86
By W. A. Koehler.

Synthetic Ammonia Costs in America 89
By R. S. Tour.

A Method of Fractionating Natural Gasoline 92
By D. B. Keyes.

Simplified Calculations in Design of Natural Gasoline Absorbers 93
By W. K. Lewis.

Alcohol-Gasoline Blend Shows Advantages in Road Tests 95

Preventing Excessive Wear in Mills for Crushing and Grinding 96
By B. E. Field.

How Do Patents Affect My Business? 99
By Roswell F. Hatch.

Electrical Heating Field Broadened by Container-Resistance 102
By R. A. Carleton.

Bursting Pressures of Brass and Copper Pipe 104
By William G. Schneider.

Products and Profits of Soap Maker Extended by Technology 105
By H. J. Morrison.

Chemical Engineer's Bookshelf 107
- The Making of a Chemical, by E. I. Lewis 107
- A.S.T.M. Standards, 1927 107
- Lubricating Greases, by E. M. Klemgard 107
- History of the Explosives Industry in America by Arthur P. Van Gelder and Hugo Schlatter 107
- The Metallurgists Manual, by T. G. Bamford and Harold Harris 108
- Steel and Its Heat Treatment, by D. K. Bullens 108
- Study of Patents Dealing with the Electrodeposition of Chromium, by Richard Schneedewind 108
- A Directory of Applied Chemistry, by Sir Edward Thorpe 108

Readers' Views and Comments 109
- Avoiding the Mistakes of the Other Fellow 109
- Parr's Product Not True Low-Temperature Coal Tar 109
- Electric Rotary Calciner 109
- Vapor-Phase Refining for Vapor-Phase Cracking 109
- Dissolving Drum Caustic 110
- Unloading Tank Cars by Air Pressure 110
- American Investments in Foreign Chemical Industries 110

Selections from Recent Literature—Abstracts 111

Government Publications 112

The Plant Notebook 113
- Condensate Flowmeter for Evaporators 113
  By L. C. Cooley.
- Agitating Wheel 113
  By L. R. Raymond.
- Detecting Condenser Leaks 113
  By W. E. Callahan.

Equipment News 114
- High Capacity Vacuum Filter 114
- Ball Mill Unit Pulverizer 114
- Motor-Operated Valve 115
- Oscillating Conveyor 115
- Lubricated Quarter-Turn Rotary Valve 115
- Steam-Operated Temperature Controller 116
- Interlocking Refractory 116
- Clarifier and Separator 116
- Valves for Severe Conditions 116
- Motor-Pump Unit 117
- New Cutting Blowpipe 117

Manufacturers' Latest Publications 117

Patents Issued Jan. 3 to Jan. 24, 1928 118

News of the Industry 119
- Committees Named to Direct Petroleum Research 119
- Austrian Interests and I. G. in Sales Agreement 119
- Perkin Medal Awarded to Dr. Langmuir 120
- T.A.P.P.I. Program 121
- London Correspondence 122
- Paris Correspondence 123
- Personals 125
- Obituary 126
- Industrial Notes 126

Market Conditions and Price Trends 127
- Glycerine Prices Weaken 127
- Chemical Production Gains 128
- Industrial Activities 129
- Market Reviews 130
- Weighted Index Numbers 131
- Current Prices 132
- Business News 133

Technical Societies, Trade Associations and Commercial Organizations 135

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CHEMICAL & METALLURGICAL ENGINEERING

H. C. Parmelee
Editor

Volume 35 New York, February, 1928 Number 2

Scientific Research Underlies Industrial Progress

IN awarding the Perkin Medal last month to Irving Langmuir, conspicuous recognition was given to the utility of fundamental scientific research undertaken without immediate "practical" objective but resulting in industrial progress measured by millions of dollars. The record of his continuous and coherent search for new knowledge forms an epic, not on the age-old themes of tradition or mythology, but of heroic achievement in solving "nature's old cross-word puzzles," as Whitney put it. Out of years of exploration in the realm of atomic and molecular physics and chemistry Langmuir brought new knowledge that found direct application in incandescent lamps, radio tubes and atomic hydrogen arc welding.

THIS personal recognition of Langmuir, richly merited, has a timely significance that warrants impersonal emphasis. American industry needs more Langmuirs. It needs more Whitneys with faith in the Langmuirs and wisdom to encourage them to explore the unknown, confident that fundamental discoveries will furnish the basis for industrial growth and progress. Indeed, if American industry is to meet and survive competition it needs more General Electrics to heed and back the Whitneys. In short, the times demand a modern attitude toward scientific research, an attitude much more modern, say, than Upper Silurian, when the first vertebrates appeared.

FORTUNATELY the signs are not lacking that faith in the necessity for scientific research and reliance in its results are increasing. In public life we have no less a protagonist than Herbert Hoover who, as Secretary of Commerce, sees clearly the permanent foundation on which American industry must build. Without decrying the value and importance of industrial research, on which 30,000 men are engaged and $200,000,000 a year is spent, he emphasizes our comparative poverty in fundamental research in which only 4,000 men are working on annual appropriations of $10,000,000. Hence his interest in raising an endowment fund for the support of scientific research.

HITHERTO most of our fundamental research has been conducted in university and government laboratories, but that work is soon to be augmented by other agencies. In a new conception and broader plan for the Mellon Institute of Industrial Research, Director Weidlein has included a program for scientific research. Much as the Institute has contributed to industrial progress in this country, its management nevertheless feels that more fundamental scientific work must be done. A similar note was sounded by Director Wendt in his announcement of the new Battelle Memorial Institute at Columbus where, in addition to immediate industrial aims, "long distance" research will be fostered.

FINALLY, the chemical industry itself is not without an illustrious example of faith in research. The du Pont organization has long been conspicuous for its reliance on science and engineering. Out of its research and development has grown an industrial structure unique for the logical relationship and coherence of its elements. That research is appreciated at the top is amply shown in the president's last report where we read that "it has recently been decided to place increased emphasis on fundamental research." With all these forces at work we can look forward confidently to the growth of scientific research in America.

When Is Chlorine a "Poisonous Gas"?

CHEMICAL industry has often suffered from legislation that Congress ostensibly intended for humanitarian purposes. A trouble-making case in point is the so-called "caustic-acid" labeling act passed during the last hectic days of the 69th Congress. A possible threat, of even more serious potentiality, is now to be found in Representative Theodore Burton's recent resolution to prohibit the exportation of arms, munitions or implements of war to belligerent nations.

This joint resolution, introduced on January 25, 1928, and known as House Calendar 136, H.J.R. 183, contains in Section 3 the following definition:

> "As used in this Joint Resolution, the terms 'arms, munitions or implements of war' means— * * * 13. Poisonous gases, acids or any other articles or inventions prepared for use in warfare."

Strict interpretation of such a provision might prove extremely embarrassing to chemical industry in its normal, commercial relations with foreign countries. Who, for instance, is to say whether chlorine is or is not a "poisonous gas"? Phosgene is one of the most effective gases used in chemical warfare, yet its peace-time use in making dyes and certain medicines is very important. The single word "acids," from a chemical standpoint, is almost as all-inclusive as is the possible interpretation of that very indefinite phrase which follows it, "articles or inventions prepared for use in warfare." It takes no great reach of the imagination to foresee the possibilities of unlimited trouble arising from the administration of such carelessly drawn legislation.

The Burton resolution should be modified to make certain that its provisions can work no hardship on peaceful chemical industries engaged in the normal export of their product. Such amendment is not likely to be effected, however, unless there is an insistent request for it. The matter is worthy of our attention as individuals, companies or as organized associations within the industry.

The More Friends The Less Waste

EVEN the most "practical" plant man will agree that the scientist's practice of beginning each new investigation with a search of the literature is the logical method of attack. Sometimes, however, he is prone to assume that his own problems are too highly specialized to be found in the library; too closely confined to some special branch of the art to be public knowledge. Wherefore, effort and money may be expended in re-establishing facts which are already available to him who knows where to look for them.

A case in point was illustrated the other evening at a purely social meeting of three chemical engineers. One of them had outlined the work he had just completed in measuring the effectiveness of acid distribution by various designs of spray nozzles. He had studied the effect of orifice sizes, location of splash plates, pressure head and other factors until he was confidently prepared to recommend the exact design best suited for his particular purpose. When he withdrew, one of his auditors remarked, "It is a queer coincidence, that although I know nothing about spray nozzles, it so happens that I could have introduced that young fellow to a man who did exactly that same work a few years ago. Moreover, I could have told him of a report somewhere in the files of his own company which covers practically the same ground."

A certain amount of duplicated effort is inevitable, even within a single organization with its numerous departments and its shifting personnel. The literature pertaining to the art is obviously the most important check on this waste, but the practical engineer does well to recognize that some of the most valuable references are cataloged in the minds of his contemporaries. Next to the library, the lounge and the luncheon table can be recommended as starting points for technical investigations.

Repaying an Obligation To the Universities

RESIGNATION of one of the leading professors of chemical engineering to take an industrial position occasioned comment by the president of that institution which industrial men, as well as educators, can well ponder. President . . . writes:

> The . . . interests of the country would better be served by leaving Professor . . . in a position where he could turn out the men needed by the industry. However, it is the same old story. Individual firms are seldom willing to take younger men, but are quite ready to pick key men at an institution, since the salary required to do this means little to the firm. This is, however, a very short-sighted policy.

This brief comment states very well the dilemma of the industrial executive who must have a research executive or an operating man and who finds a likely prospect in one of the educational institutions. The individual company sees an immediate advantage in the taking of such a man. But the industry as a whole is bound to suffer if such a change in position breaks down the organization for teaching at one of our major chemical engineering institutions. The problem of the industrial executive is, therefore, to determine whether the immediate selfish interest of his company warrants the long-run deprivation of his industry through curtailment of supplies of well trained personnel for the future.

From the standpoint of the individual professor no one can question either the right or the desirability of accepting more lucrative appointment when it is offered under attractive conditions in industry. It is a marvel that more of our educators are not tempted beyond their strength in this direction.

There seems to be only one real solution for the problem as a whole, namely, better compensation for the professors. Obviously this can not come from fees of the students who already pay all they can afford. It must come from the general endowment of the institutions or from special professorships founded by individuals or by industrial groups in the furtherance of technical education in their particular fields.

The time must come, and it should come soon, when the leading men in various colleges who have proved their aptitude for teaching shall be so generously compensated from endowed professorships that they need not be tempted to move to less congenial surroundings in industrial work. This does not require that every faculty man in every chemical engineering department shall be so paid. Usually there are only two or three key men, in many cases only one vitally necessary man, in the chemical

engineering department. The other positions required must, of course, be filled by competent individuals; but they can usually be filled by younger men who take such work for a period of five or ten years merely as a stepping stone to better industrial opportunity. Though the turnover in such minor positions may be great, there can and must be a continuity in policy through long service of the men holding the key professorships.

It would be logical for those great industrial organizations who profit most by taking the best talent of our universities to repay the obligation thus incurred by the founding of high-salaried professorships which will not be open to such distraction.

"Hair of the Dog" for the Wood Distillation Industry

ECONOMIC body-blows are nothing new to the hardwood distillation industry. The ascendency of coke over charcoal for metallurgical operations, acetone by fermentation, acetic acid from acetylene and synthetic methanol have struck at the four main props of the wood distiller, but he refuses to fall. In fact, he accepts his tribulations as just deserts, resulting from his early neglect of the very technique with which his adverseries now plague him—chemical engineering and research. Moreover, he purposes to make up for lost time in his zealous acceptance of this credo to which he has been converted by competitive cudgels.

Wood distillation will not be abandoned as long as there is a plentiful supply of raw material, but an elimination of many of the smaller plants or a combination of these plants with the larger and better equipped is inevitable. Thus, although we may see a reduction in the number of plants, we should see also the establishment of a system of better operated plants with improved apparatus, closer operating control and higher yields.

New uses for staple products and new products from staple sources are twin avenues to progress and profit for the wood distillation industry as for every other producer. For example, settled hardwood tar is a product of this industry which has never received the attention which it deserves. One is almost inclined to say that we know less about this material today than was known at the time Reichenbach made his investigation a hundred years ago. That it is the source of many valuable products there is no question. A number of uses have been found for certain of the products from this tar, but a closer study of these products is needed to develop their uses to the fullest possible extent. Also, co-operation between the distillers, whereby the products from the distillation of hardwood tars may be standardized is most essential. This factor is undoubtedly one of the most serious drawbacks to the marketing of hardwood tar products. Not only are there variations in the tar itself, depending upon the temperature and process used in its production, but also in the distillates and residue. It should be the aim of the distiller to overcome this lack of uniformity in order to make hardwood tar distillation a successful adjunct of wood distillation industry.

An industry of the dimensions of wood distillation in the United States cannot resign itself to fate. That it does not intend to is indicated by the growing ascendency of the technically trained man. The industry relies on the old fashioned prescription, "a hair of the dog that bit you."

Help Establish a New Census Record

BRITISH chemical journals have just heralded the appearance of the preliminary report of the 1924 census of the production of chemicals and allied products in Great Britain. The figures thus made available appear to have a fascinating historical significance and many interesting academic comparisons are being made with the returns from the last preceding British Census of 1907. From an American viewpoint, of course, a 17-year interval between the release of 4-year old figures would practically destroy all usefulness of the data.

Since the beginning of Mr. Hoover's administration of the Department of Commerce in 1921, our census of manufactures has been on a biennial basis. Accordingly, 1927 was a census year and the Government has already sent out its requests for basic data on commodity production. To fill out these questionnaires promptly and conscientiously is not only an obligation, but is an opportunity to render a real service to American industry.

The Census Bureau stands ready to do its part—in fact is anxious to establish a new record in collecting and making available current data on production. In the past it has taken from a year and a half to two years for the Bureau to complete its final tabulation of basic data, although reports on special industries have always been available within a year after the taking of the census. This year, given prompt co-operation by American manufacturers, the Bureau hopes to make the summary figures available to the public many months ahead of previous censuses. If we are to continue in the "statistical paradise" that our British friends must envy, chemical industry must co-operate promptly and effectively with the Census Bureau.

Euclid and the Chemical Engineer

EINSTEIN would have us believe that the straight line is not necessarily the shortest distance between two points. Fortunately for the plant designer, the deviations postulated by the theory of relativity are too minute to complicate a matter already sufficiently difficult, and becoming continually more complex as the diversity of production requirements is accentuated. It would be well for the chemical engineer to renew his acquaintance with the Greek mathematician.

Elsewhere in *Chem. & Met.* is described a modern epic of the straight line. Where we would least expect it, there we find the application of straight-line production methods and scientific management which almost put to shame that patron of these arts, the automobile industry. In one building of the plant of Eli Lilly and Company, pharmaceutical manufacturers, is equipment for the production, from time to time, of nearly three thousand different products.

It takes scant knowledge of pharmaceuticals to realize that here, if anywhere, control must be perfect. It has been demonstrated that mass production methods have not only failed to lessen close control, they have actually improved it. Management which looks ahead, production which eliminates waste motion and handling, inspection which inspects have all joined hands to throttle the diversity bugaboo into abject submission. Euclid and his disciple Frederick W. Taylor, father of scientific management, have taught their lessons well.

The Men Who Make The Wheels Go 'Round

OLIVER will always typify the dyed-in-the-wool acid operator to those whose destinies were bound up with that of Contact Plant Number X. The gray "acid pants," the pool-table-cloth shirt and the ever present chaw which "protected the teeth against the fume" became Oliver as could no other regalia. He was a little vague in subjects cultural, but he could talk to a contact plant and make it answer. He had some unique theories, such as his favorite explanation of why the drive chain on the sulphur burner broke so frequently. He never convinced anyone, even his subordinates, that a ventilating hood over the burner would cure the trouble by carrying off the excess heat. But he was never called on to explain why production dropped off on his shift. In short, he was a fine specimen of American workman who knew his job, liked it and was proud of his record.

Oliver was recalled to mind by a recent chat with the young superintendent of a well-established dye plant. Analyzing his daily routine, he found that an unreasonable share of his time was devoted to training operators, supervising their ordinary duties and guarding against the effects of their carelessness or indifference. Personnel turnover was high, and the reason was generally to be expressed in terms of two or three cents per hour. Thus, a high-salaried man, with a splendid fund of operating experience was functioning largely as a foreman, while other trained men, without the background of dye works experience, had to be broken in to conduct plant experimental and development work. A slightly increased hourly rate would have produced some Olivers who would have relieved the superintendent of much of his routine, leaving him free to apply his experience to constructive developments and releasing some of the experimental crew for other work. Everyone would have been happier, production would have been improved and costs would not have increased.

Perhaps we underestimate the capacities of our Olivers. Perhaps they can not explain the theory of catalysis, but if they can average 97 per cent conversion, who cares? Human, tolerant, aggressive, instinctively loyal and permeated with the progressive spirit of American industry, they are the real vertebrae of our industrial backbone. Some day, another Joseph Pennell will create a monument to them. Meantime, Oliver will be well satisfied with an occasional radio set or a new tire, and in the long run his satisfaction is likely to be pleasantly reflected in the cost sheets.

Good Economics But Poor Technology

A WEIGHTED index number of chemical prices derives its value from the fidelity with which it reflects actual conditions in the chemical market. If the method of weighting permits the fluctuation in price of a single commodity to have a predominating influence or if through lack of technical knowledge incorrect data are used in the calculation, then the index number fails to serve as a reliable gage of market trends. These observations, arising from a half-dozen years' experience with the *Chem. & Met.* weighted indexes, are prompted by a regrettable inaccuracy in the chemical index number of one of the most progressive and responsible of our trade associations.

In its service letter of January 24, 1928, this association charts its weekly price index number according to commodity groups. Between the weeks of December 31 and January 7, at a time when the "all commodities" index showed a slight rising tendency, the chemical index number fell abruptly from 89 to 77 per cent of 1926. In explanation of this collapse one finds the surprising statement, "Chemicals showed a sharp decline for the first week in January due to a large reduction in the import duty on alcohol." Since ethyl alcohol is not being officially imported into the United States and since tariff reductions under the present administration have been notably few, an investigation seemed in order.

Our inquiry developed a number of interesting facts which are cited here to show the danger that may arise from mixing good economic procedure with poor appreciation of chemical technology. The association selected alcohol as one of the important chemicals for its index number and proceeded to weight it according to the standard method of multiplying volume of consumption by price. The gallonage was that for *denatured* alcohol, but the prices, for some unknown reason, were those of *tax paid pure grain alcohol*. Naturally, the difference between $3.75 and 48 cents a gallon resulted in a widely extravagant weight for this material and gave it a predominating influence on the chemical price index number. Accordingly, a reduction of $1.05 in the price of U.S.P. alcohol due to a revision in the rate of internal revenue, produced a 15 per cent change in the association's composite price index for all industrial chemicals. As a matter of fact during this same period denatured alcohol, which is probably twenty times more important than tax-paid alcohol, showed an actual rise in price. Correctly calculated, the association's index would probably have mounted slightly instead of having dropped so abruptly.

These facts are not given here in any spirit of unfriendly criticism or fault finding. The association, we are told, plans to revise its methods of calculation and will shortly publish corrected values for its chemical index number. The fact remains, however, that chemical industry should not be subject to such influences nor its progress measured by faulty methods.

A Prophet Lifts the Veil

THE curtain rolls aside and one of the country's leading engineers and educators permits us a brief glimpse down the mist-enshrouded avenue of Time. For a moment we are able to envisage a little of what life may be a century hence when the trends that are even now beginning to manifest themselves have had opportunity to come to some measure of their full fruition. There are none among us who may call the picture false. To each man his privilege of skepticism, but to every imagination the right to stir our own with visions of the future.

In the cornerstone of a building which was recently demolished in Cincinnati, there was found a prediction for the present, placed there eighty years ago. At the instance of those responsible for a new building, now being erected on the site, Dean Schneider of the University of Cincinnati prepared a prophesy which was read at the dedication ceremony and then walled up in the cornerstone for posterity to read.

No idle fantasies, these, no chimeras. The world is awakening to the scarcity of the impossible. The temptation is strong within us to paint the picture in even bolder colors, to set no time limit upon achievement and to turn our glass upon the day when the identity of energy, matter and thought processes will be universal knowledge. But Time veils the picture in incomprehensible grays. The view which Dean Schneider gives us is nearer home. It is more nearly within the understanding of the twentieth century mind.

Psychology, now in an alchemic stage, will have awakened to take its place as one of the two great sciences, the sciences of mind and of matter. It will have undammed the pent-up reservoirs of mental energy in every brain, to the great improvement of bodily, mental and relational health of individuals and nations. Science, religion and philosophy will walk side by side. Selfishness will become enlightened and do away with mutual destruction and human hindrance.

The energy in the atom will become available to supply our power. An understanding of gravitational attraction will give the key to flying machines which will not be dependent upon air pressure for their support. Space will be conquered by the projection of sound and sight, if not thought. This may minimize the necessity for distant travel and bring about the decentralization of populations.

Diagnoses of diseases will be quick and accurate through spectroscopic means. Electromagnetic waves, properly controlled will bring about most cures, with surgical operations reduced to a minimum. Similar waves will be used to improve foods and living organisms. Molecular synthesis will become a common art.

And yet, the historian, in his prediction of the future from the past will not be far wrong. For man does not change fundamentally. Science and knowledge alter his externals, but basically he will remain much as we knew him, much as his neighbors knew him at the dawn of history. He will become enlightened, but the genus *homo* will remain.

An Antidote for Specializitis

WHEN the "popular" style of literature on the "marvels of chemistry" was a novelty, it wasn't so bad. A certain amount of "hokum" was expected and tolerated by educated readers because it was recognized that the prime mission of such treatises was to interest and inform the lay public. Now that the novelty has worn off, however, the diet begins to pall. One sighs a bit over the "laid-end-to-end" figures, turns the page and hopes. Then "suppose the atom were enlarged to the size of a hickory nut" provokes a restrained yawn, but hope still lingers. Eventually, however, the inevitable happens, for without so much as inviting us to "stop me if you've heard it," the author presents an intimate account of his private life, beginning with the chemically active first rays of the sun shining through chemically made glass, on synthetic-dyed draperies, artificial leather slippers, etc., continuing through a Thorpe Dictionary day to a chemically pure but contagious slumber. One is tempted to speculate that if all the "chemical days" thus chronicled were laid end to end . . . but perhaps that is unkind.

Let no one underestimate the tremendous progress made in the past decade in educating the layman to an appreciation of the ubiquitous benefits of science, particularly of chemistry. Let no one scoff at the ingenious art of making first page news of technical developments. Let us freely acknowledge the genius of those scientifically trained men who saw in this field their mission, and are effectively materializing their vision. Such recognition involves no inconsistency, for we are confident that Dr. Edwin E. Slosson, for instance, will never knowingly tell us the story of his "chemical day." In fact he is quick to recognize the existence of a great group of readers who are loath to wade through "a long-passed freshman course in elemental science all tangled up with what might be really meaty bone of new fact."

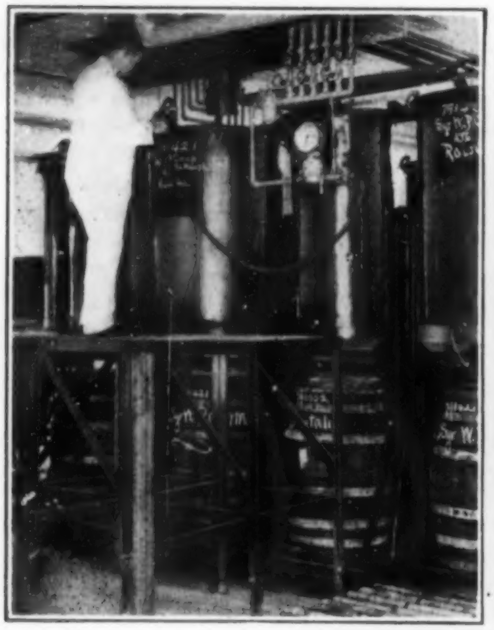
The announcement that Doctor Slosson is preparing a series of books written "straight across" to a discriminating group instead of being "written down" to a relatively unschooled reader, is interesting and promising. Such a series will find a welcome with the well-educated reader who wants to know something about what is going on outside his own specialized bailiwick. Perhaps it may even revise the curriculum of the "popular" school of literature and relegate such old favorites as "And so the ancient alchemists were not so far wrong after all," to an appropriate place beside the daily bed-time story.

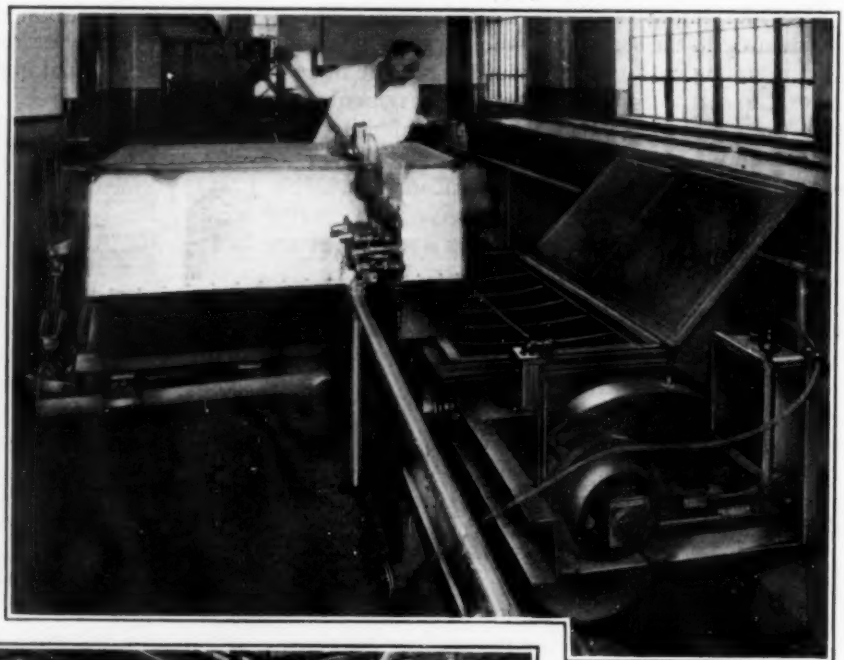
Chemical Kinship

BEGINNING with a single powder mill 125 years ago the du Pont company has grown until its present commercial activities include the widest range of chemical manufacture. Among all its products, however, there exists an intimate relationship which President Lammot du Pont has recently called to the attention of the stockholders in his annual report for 1927: "The diversified chemical industries which constitute your company's business are basically closely related. This relationship consists of similarity or identity of raw materials and processes of manufacture." The point is further illustrated by an interesting chart that bears the caption "The Kinship of du Pont Products."

It is the recognition of this kinship of materials, chemical-engineering processes and personnel that *Chem. & Met.* is trying to crystallize in a series of articles on "The Inter-Dependence of the Chemical Engineering Industries." A dozen of the industries of the group were discussed from this point of view in the January number. An article on the soap industry by H. J. Morrison of the Procter & Gamble Company appears on pages 105 and 106 of this issue. Other contributions to the series will be published in subsequent numbers until the entire chemical engineering field has been covered.

The series as a whole will serve a number of useful purposes. To the chemical engineer in the specialized field the articles offer an insight into the operation of the related industries in which chemical engineering knowledge and experience may be applied. To the student they supplement the college curriculum in helping to give a definite sense of direction to the educational processes. The manufacturer of chemical engineering equipment will find them useful in studying the market for his products and extending their industrial application. In fact all in the process industries will eventually profit by any comprehensive attempt to bring these various elements together into a closely knit and co-ordinated profession of chemical engineering.

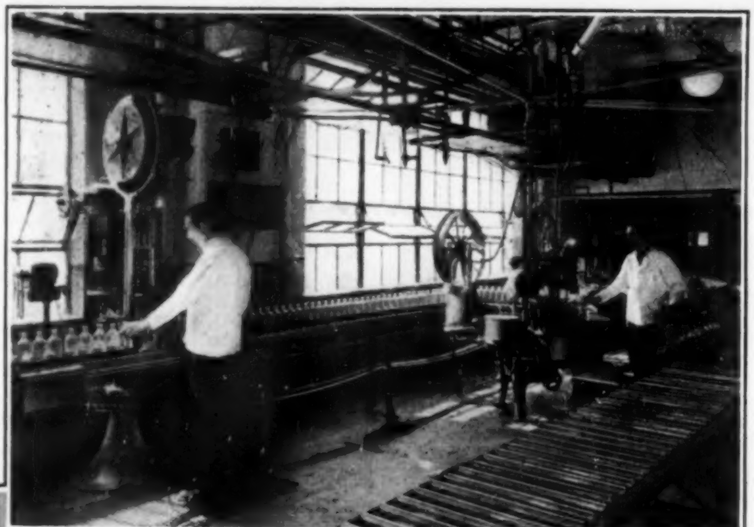




Ground drug is charged as above, from the metal boxes into which it is ground, into a mixer mounted on tracks so as to dump to any one of the several large percolators located directly below. Here it is mixed with sufficient menstruum to thoroughly moisten it.

At the left is shown the bottle belt along which are situated machinery for filling and capping bottles of liquid products.

Several Views in the Eli Lilly Plant



The packing station for the percolator carrousel is at the upper left. Moistened drug from a small mixer on the floor above is packed with additional menstruum into each percolator as it comes up on the carrousel. The percolators may be stopped at any time for packing or other attention.

Above is a finishing belt where liquid products are labeled, wrapped and cartoned preparatory to packing in dozen or gross lots.

Tanks where fluid products are prepared are shown at the right. The conveyor which serves this department is situated at the extreme right of the picture.

Applying Mass Production Methods in a Pharmaceutical Plant

By Theodore R. Olive
Assistant Editor, Chem. & Met.

THE IDEA is current among chemical engineers that the manufacture of pharmaceuticals is necessarily a laboratory process, that the apparatus consists of little more than the mortar and pestle, the flask and beaker, the spatula and glass funnel with its carefully folded paper filter. Even the most casual examination of the new Eli Lilly and Company plant at Indianapolis, must indicate that nothing could be farther from the truth. Here, among the most delicately controlled of fine chemicals, forethought, planning and well conceived chemical engineering practice, have combined to make possible a single building in which, from time to time more than 2,800 different products are produced by straight-line, conveyorized methods combined with scientifically controlled production.

So smoothly does the system operate that the observer is almost totally unaware that there is a system. It is difficult for him to realize that the products do not "just grow" as did Topsy, that every operation in the plant is being watched from a central planning department. In fact, every operation has been anticipated long in advance, and the characteristics of every machine, every producing unit and every operation required in this multiplicity of product have been time-studied and standardized. What the automotive industry has accomplished in the assembly of parts as a whole from a multitude of individual parts, Lilly has done equally effectively in the compounding of numerous ingredients into almost as many finished products. The automobile manufacturer is at one extreme of conveyorized production with Lilly at the other.

THAT SUCH RESULTS in economy and accuracy of production control are possible under a condition of this extreme complexity of manufacturing requirements indicates very convincingly the possibilities that scientific management and chemical engineering pioneering hold for the process industries. The new Lilly manufacturing building was built around a ground-work of Taylor's system. Production requirements were studied and the manufacturing methods standardized over a period of years. With this basis the installation was designed with an accuracy consistent with the planned production schedules that are now being carried out. The foresight which produced the plant and equipment is now reflected in a planning department which is the brain of this complex organism.

While these very modern methods have likewise been applied to the production of biological chemicals (serums and vaccines), the lessons to be observed are best found in the single new manufacturing unit which is given over to the production of pharmaceuticals. Among these may be listed principally filled capsules or pulvules, powders, pills, tablets, ointments, extracts, emulsions, and elixirs.

Very little of the producing capacity of the plant is concerned directly witih orders for customers. Almost all manufacturing is performed in compliance with production schedules set in motion by means of a perpetual inventory system employed by the stores department. Every item normally carried in stock is controlled by high and low stock limits which automatically start the machinery of production before a shortage can occur. When it is indicated that more of a product is to be made, the planning department immediately issues the necessary raw material requisition and manufacturing instructions. The amount called for is standard for this product and is based upon formulas which balance demand against manufacturing costs and the investment tied up in stock. The formulas are constantly corrected for changing conditions of market and material costs.

WITH the production determined, the next step is to issue orders to all departments concerned. Each product of the 2,800 and more, has on file in the planning department, complete specifications covering materials, procedure and manufacturing instructions. This is blueprinted and sent out as soon as the planning board shows that the equipment will be available when material is on hand. The instructions which go to the raw material section contain detailed specifications of all materials required. Not only is there a complete material list with weights of everything needed for the formula clearly indicated, but there are also coupons which are attached to each raw material container at the time of assembly to show the nature and weight of the contents. The detailed instructions travel with the order from the time of its inception until the finished product is upon the storehouse shelves, and indicate to each department both how and when every step is to be undertaken.

Through the reports of each department, the planning division is constantly in touch with every operation in the plant. The office of the superintendent, using information of this latter sort combined with the time study standards, is able, three times a month to send out to the departments interested, a report showing the status of the work processed as compared with the scheduled production. This report also includes a figure for operator efficiency based upon the time standard for the unit operation. The effect is to keep the departments running constantly at top speed in a spirit of friendly competition. It should be noted in this connection that these planning methods level out production fluctuations so effectively that the labor turnover is very low for this industry.

The efficiency of the Lilly plant is dependent upon the

fortunate combination of scientific planning with straight-line production methods. How straight-line methods are applied to such a numerous product coverage will develop as the effect of the conveyor system is traced through the plant. This system was jointly designed by Lilly engineers and by the Logan Company of Louisville, and was built and installed by the latter. It constitutes the arteries and veins of the entire manufacturing individual. Orders which are issued from the planning department, the brain of the individual, set in motion the various functions of the body. The raw material section, the heart, is caused to dispatch the component ingredients for the different operations to the proper places by means of the arteries — the conveyor system. Meanwhile, minor conveying requirements are handled by branch conveyors, the veins.

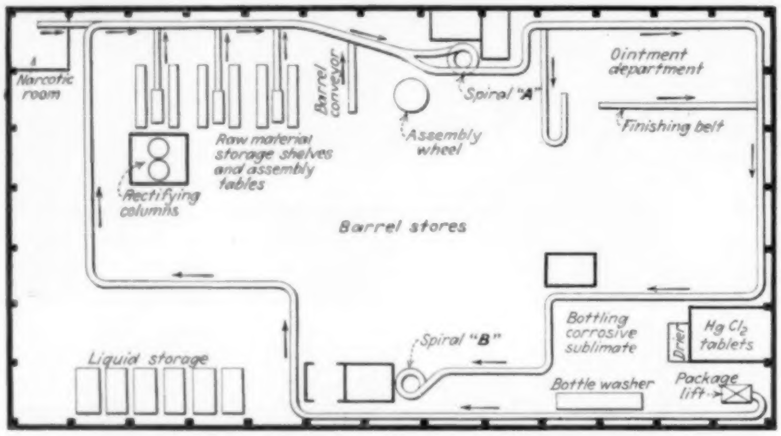


Fig. 1—Fifth Floor, Lilly Pharmaceutical Building

This floor includes the storage of most raw materials, as well as the manufacturing departments for ointments, dental preparations and corrosive sublimate tablets. Here are prepared the excipients or syrups for pill and tablet manufacture. The conveyor system which ties the entire plant together starts on this floor in the raw material stores section. From this point, materials may be dispatched via spiral "A" to the departments manufacturing dry products on the fourth floor or to those manufacturing liquids on the second. Or, the materials may circle this floor and descend spiral "B", to be delivered to the third or first floors, which are respectively the packaging and finishing departments for dry and liquid products.

In the case of single products and classes of products which require similar treatment, the manufacturing facilities are grouped together so that there is practically straight-line flow of material from the raw material stores at one end through the processing, finishing, inspecting, packaging, storing and final packing stages to the shipping department. Gravity is made to actuate the greater part of the material handling equipment through the use of free conveyors wherever possible, as well as by inter-floor chutes for solid material or material in containers, and through pipe lines for liquids. The manufacturing floors on which are produced the solid and semi-solid products feed a single floor below where packaging is carried out. Liquid products similarly flow to a lower level where they are bottled. The materials from the two packaging floors are gathered by the conveyor and transported to the storage building from which they may be withdrawn for conveyor distribution to the packing and shipping departments.

It should be emphasized here that visual inspection, as well as control analyses, are applied at every possible point throughout the manufacturing procedure. Scientific control as to the quality of both crude and finished materials, and the accuracy with which the products are compounded, is most rigid. This is carried out by a scientific department consisting of chemists, pharmacists and botanists who apply standard tests and assays to purchased materials and finished lots of manufactured products. Over 10 per cent of the factory personnel consists of checkers and inspectors supervised by the scientific department. It has been demonstrated that conveyorized methods do not in any way jeopardize accuracy, but rather inject a measure of safety which cannot be secured when materials are handled haphazardly, and with manual transfer.

The new manufacturing building which is of the most modern type of fire-resisting construction, consists of six floors and a basement. The top floor is given over to ventilating and air-conditioning equipment, and to steam-operated water stills. There are also a number of dust-settling rooms to which the process dust from every point in the plant is conveyed and where it is retained through the lowering of the conveying air velocity.

On the fifth floor all raw materials, in so far as possible, are assembled for distribution to the process departments. The enormous amounts of alcohol used, both grain and denatured, make it imperative that this material be stored in 12,000-gallon tanks in the basement. From these tanks the alcohol is lifted by air pressure to headers conveniently located for processing. Pressure is maintained on the lines during working hours so that it is only necessary to open a faucet at any using point to secure the alcohol needed. Since the faucets are provided with locks, this convenience is not abused, for operators are provided with the proper key only at the proper time. At the close of each working day, the pressure is released and the alcohol in the line allowed to drain back into the basement storage tanks. All alcohol which has been used for extraction purposes and has been recovered from the stills in which the extracts are dried is collected in waste tanks located in the basement, later to be brought back to 190 proof by rectification.

On the fourth floor storage space is provided for the crude drugs until they are ground. They are examined at this point by a botanist, and finally charged into grinding mills on the floor below through hoppers which are accessible from this floor. All chemicals, however, all oils, sugars, specially denatured alcohol, and (except for grain and ordinary denatured alcohol) all liquids which enter the processes, are first delivered to the fifth floor. Elevators and package lifts conveyor such material as is not pumped from the receiving department. The sugar powdering mill located on the third floor adjacent to the crude drug mills is fed from the fifth floor where carload lots of granulated sugar are stored.

Less bulky material items are stocked on parallel rows of shelves, or beneath the shelves when the materials are handled in barrel quantities. Materials are arranged on the shelves in order of their importance with items of a similar nature grouped in one section. The shelf rows are arranged in pairs between which are located the weighing and assembling tables. Leading away from each table is a branch conveyor for transporting the packages to the main conveyor line and thence to the checker or verifier. Space is allotted between the sections for the

storage of barrel surplus, with these items placed directly behind the active stock. Narcotics and drugs which have a high degree of potency are confined in an adjacent enclosure under lock and key.

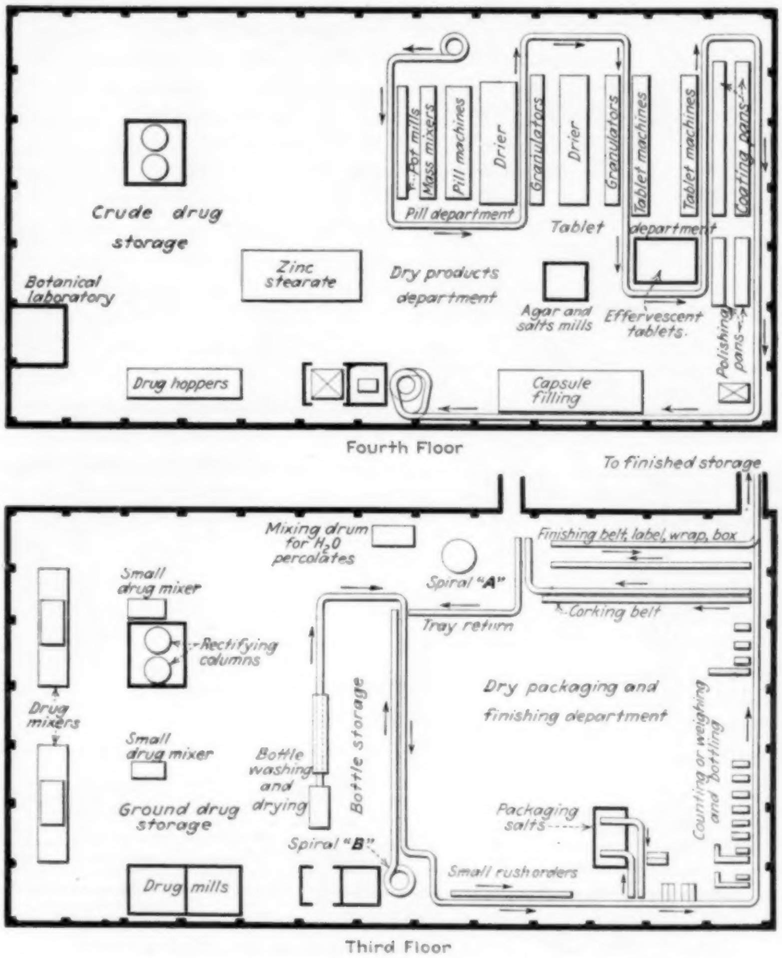


Fig. 2—Third and Fourth Floors, Lilly Pharmaceutical Building
These floors are devoted to the manufacturing, packaging and finishing of most of the dry output of the plant. Manufacturing is carried out on the fourth, with packaging and finishing on the third floor. Finished goods leave the third floor by conveyor for the storage building. These floors also provide storage space for crude and ground drugs to be used in the production of extracts. Drugs are fed from hoppers on the fourth floor into mills on the third, later to be mixed on the third with alcoholic menstra in preparation for the extraction processes on the second floor.

When a material requisition is received in this department, the order is made up at the assembling table. Each package is labeled with a coupon bearing the weight, nature and production order number of the contents. The coupons are detached from the original printed requisition which was issued by the planning office. A duplicate coupon is placed in an envelope attached, for inventory purposes to the original container from which the material was taken. Then a checker compares the coupon withdrawal record with the master requisition, thus making certain that the correct material has been supplied.

When the ingredients have all been assembled in baskets, they are taken by the branch conveyor from the assembling table, and transported by main conveyor to a verifier who also acts as dispatcher. The latter, using the manufacturing instructions which accompany the materials, checks both weight and list. Everything which comes to him is removed from the conveyor and held temporarily upon a rotating assembly table. A delivery to each of the manufacturing departments is scheduled once a day. At the proper time, by touching a control, the dispatcher sets the electrical stop system to hold the delivery at any desired station adjacent to the particular piece of equipment where processing is to start. Signal lights inform the dispatcher as to the state of the conveyor line.

The material assembling conveyor may discharge either to the several manufacturing departments on the same floor or to those on the fourth and second. On this floor, the fifth, are the departments for processing, finishing and packaging of ointments, glycerin suppositories and dental preparations, as well as for the manufacturing of corrosive sublimate tablets and simple elixirs. The latter are used as a base in the manufacture of the elixir products on the second floor. Excipients or syrups, for pill masses and tablet granulations likewise originate at this point and flow by gravity down to the fourth floor.

The base of most ointments is petrolatum. The entire stock of this material is carried on elevated tracks in the drums in which it arrives. The drums are rolled when they are needed into a hot-house and held there with the petrolatum in a melted state until it is required for processing. The fluids are withdrawn through faucets outside the hot-house into containers resting upon a floor scale. Porcelain pebble mills and attrition mills similar to those used in paint manufacture combine the additional ingredients with the base materials. Automatic filling machinery packages the products in jars and collapsible tube containers, which are taken to the finishing belt where operators inclose the filled containers along with any printed matter in paper cartons. Baskets of finished ointment packages are finally sent by conveyor to a central packing station on the third floor where most of the product is placed in corrugated boxes ready for distribution.

Equipment in this department, as in all of the plant, is arranged in sequence to permit the logical flow of work from operation to operation with the minimum of handling. This results in the smallest possible amount of labor, and curtails pedestrianism to a minimum.

Corrosive sublimate tablets, because of their danger and because their manufacture does not lend itself to machine processing, are made on this floor, separate from the tablet department on the fourth. All work is done under glass enclosed, ventilated hoods. Bottling is performed immediately on hooded tables and the bottles forwarded by conveyor to a finishing belt on the third floor where packaging is completed.

Circulating containers—bottles, cans, drums, pans, and so on—are returned from all manufacturing departments to the fifth floor by means of a package lift. Here they are washed and recirculated through the conveyor system.

As has been indicated, a portion of the fourth floor is given over to the storage of crude drugs. The remainder of the floor is divided into a number of manufacturing departments served by the main line of the conveyor, which brings in the crude materials coming

from chemical stores, and carries away the finished product to the floor below for packaging. These departments include the manufacture of pills and tablets, effervescent products, ground and prepared agar, and powders and filled capsules.

As the conveyor enters from the floor above, it passes a line of pot mills where all pill, tablet and filled capsule materials requiring trituration are first processed. Materials are automatically discharged from the conveyor on raised platforms adjacent to the mills. After the pot mills are the pill-massing machines, served by excipient lines from the fifth floor. These are kneaders and mixers for the mass or dough which is produced for the following steps. The mass is placed in the pill cutting and forming machines which roll soft pills from the material. The pills are carried on belts past sorters and dropped into trays filled with powder. Trays are placed in a rack attached to a chain conveyor and carried into a tunnel drier. When the pills have hardened, they are taken from the drier and screened by machine. Containers of pills may then be taken by the conveyor and discharged at any one of several groups of pans in the coating department, when coating is to be applied.

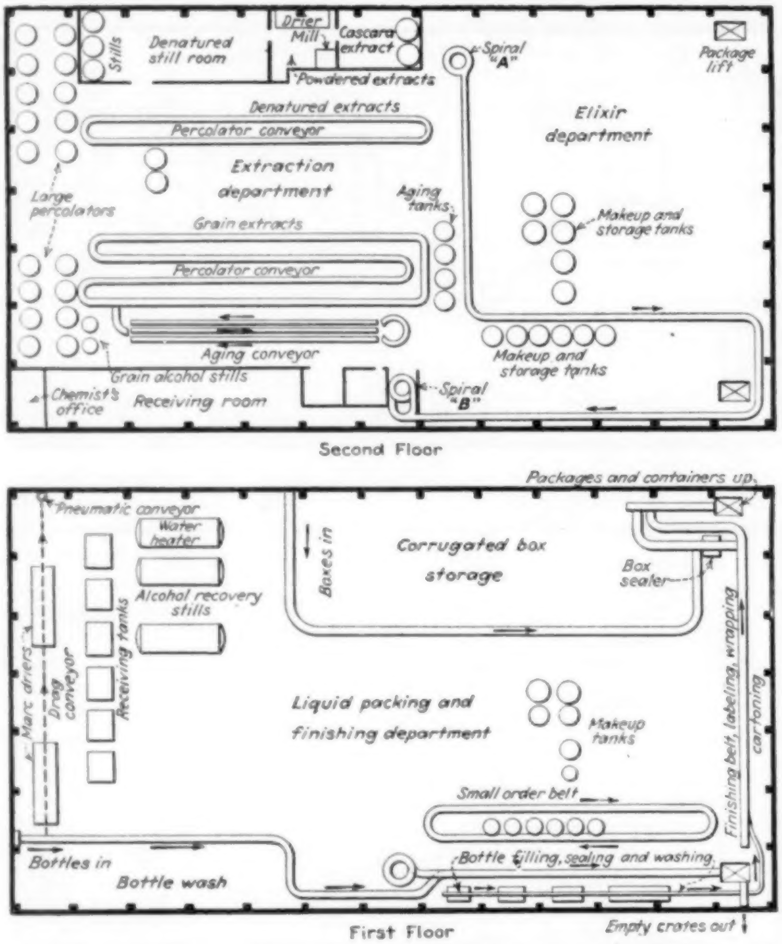


Fig. 3—First and Second Floors, Lilly Pharmaceutical Building

The second floor contains the extensive equipment used in the production of dry and fluid extracts. Extraction is accomplished in false-bottomed tanks called percolators, of which, those of large capacity are stationary, while those of small are mounted on continuous carrousel-type conveyors for ready attention. Here also are produced elixirs, emulsions and other fluid products. On the first floor is the equipment for the recovery of the alcohol used in extraction, including driers for the spent drug as well as condensers and stills. Below the elixir department is the equipment for packaging and finishing the liquid products. Here these products are also cartoned, and removed by package lift to the third floor and thence to the storage building.

The next operation, also served by the conveyor, is that of tablet manufacture. The first step in this case is mixing and granulating. After dry mixing, the ingredients are moistened with sufficient fluid to produce a granular product which is put in a drier similar in construction to the one used for pills. The dried materials are ground and sent to the tablet compression machines. These machines are most interesting because of their mechanical features and their extreme accuracy as measuring devices. Each is equipped with interchangeable punches and dies of various sizes and shapes so that a comparatively small number of machines will handle a great variety of output. Some of the machines will produce as high as 1,500 tablets per minute.

A large percentage of the tablets manufactured are dispensed uncoated. Those that are coated are directed to coating pans by means of conveyor stop controls as in the case of pills. The tablets or pills are placed in the pans with the coating material and are tumbled for a time which may amount to several days. After coating, any material which is to be polished is tumbled again in waxed canvas lined pans until a high polish is attained, after which the product is passed over an inspection belt before being sent to the finishing department on the floor below.

The final manufacturing department situated along the fourth floor conveyor contains the capsule filling equipment, which consists of highly specialized automatic machinery capable of turning out filled capsules at an enormous speed.

Drug extraction, accomplished through the use of both grain and denatured alcohol, involves the use of portions of several floors. Briefly, this consists of crude drug storage on the fourth floor, grinding and storage of the ground drugs on the third, extraction on the second and recovery of alcohol from exhausted drugs on the first.

Drugs are ground in high-speed disk-type disintegrating mills located in dust-tight rooms on the third floor. Large metal boxes carried on lift trucks and pushed under the mills receive the ground drug. Dust protection is provided by a suction curtain which extends around the entire dusty area, and embraces also the region where mixing equipment is located.

The mixing equipment in which the drug is moistened before being packed into the percolaters on the floor below, consists of four trough mixers equipped with horizontal scroll flights. Two of the mixers are used in connection with grain alcohol extracts, while the other two are used for the denatured extracts. Of each pair of mixers, one is a large piece of apparatus mounted on tracks over a slot in the floor so that it may be moved longitudinally to discharge its load to any one of a number of 2,000-lb. percolators. The small mixers are stationary and serve a line of small sized percolators directly below which are arranged on an endless carrousel-like conveyor. Beneath the outlets of the two small mixers, are charging platforms to which the small percolators are moved by means of the carrousel for charging and other attention. The percolators consist of false bottomed tanks which are charged with wet drug

and added menstruum. After a steeping period, the menstruum is allowed to trickle slowly from the drug through the false bottom and into a receiver below. The large percolators have, as receivers, 1,500-gal. collection tanks on the first floor. Copper-lined barrels, mounted on the carrousel directly below the small percolators serve the latter. Scrubber towers are provided to recover all alcohol vapor from the percolators.

When the drug has been completely exhausted it is removed from the percolators and carried by chutes or conveyors to large rotary vacuum driers which recover the alcohol and dry the exhausted drug or marc. When the marc has been dried it is taken by means of a drag conveyor and a pneumatic system to the boiler room where it may be burned. The recovered alcohol is condensed and run to waste tanks, later to be rectified.

When the extract is completed it is aged, if necessary, in large receiving tanks or on an aging conveyor in the small receivers previously mentioned in the case of small percolator batches. The aged extract is pumped through filters into bottling tanks on the second floor.

All denatured alcohol extracts are completely dried and the alcohol recovered for rectification in large copper vacuum stills which yield an alcohol-free product. The extract may be produced either in the solid form as taken from the still, or it may be further dried in pans in a vacuum drier and powdered in a disintegrator.

Types of bark of which cascara is representative yield to water extraction. Such drugs are dumped into a hopper on the fourth floor which discharges to an open false bottom tank on the second. Hot water is continuously drawn through the drug and simultaneously concentrated under vacuum in a vertical tubular evaporator.

The half of the third floor not used in connection with extracts serves as the finishing department for dry items. Here pills, tablets, powders and effervescent salts are filled into containers, labeled and packaged. Deliveries from the floors above are brought in by the conveyor beside a section given over to bottle storage, washing and drying. Bottles needed for the batches are forwarded with the material to the filling section. Thence the filled bottles go to a cottoning and corking belt after which they are passed through a labeling machine and along a finishing belt where wrapping and cartoning are done. Finished packages are then taken by the main-line conveyor to finished stock storage. Storage for finished goods is in a separate building, access to which is provided by means of the conveyor just mentioned.

The remainder of the second floor is devoted to the manufacture of elixirs, syrups, emulsions, and miscellaneous liquid products, most of which are handled in enameled steel tanks, mounted through the floor. Convenient to each make-up tank is a series of multiple header lines from which alcohol, glycerin, distilled water and simple elixirs can be drawn through meters as required. Similarly, oils and miscellaneous liquids are piped directly to the tanks where they are needed. All liquid products are filtered through plate and frame presses into storage tanks on the same floor from which they are drawn by gravity to filling machines below.

The first floor, in addition to part of the extract equipment, contains the bottling, labeling and packaging machinery for liquids, as well as storage for bottles and corrugated boxes. Automatic bottle washers, bottling machines and labelers follow in sequence. Then comes the wrapping and cartoning belt after which the cartons are packed in shipping cases and passed through an automatic sealing machine which delivers by lift to the third floor and thence by conveyor to finished stock.

Goods called out of stores are assembled and conveyed to the shipping platform. Conveyor lines ahead of the packers provide adequate facilities for checking. Other lines running beside the packers bring in boxes and barrels and carry them away to the drays when packed.

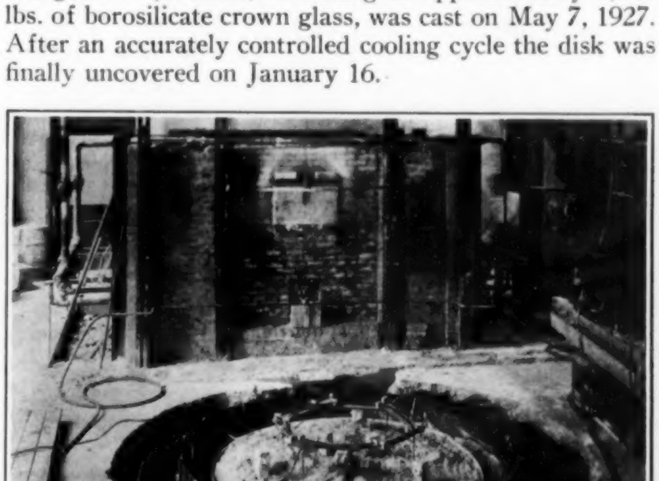
While the foregoing description has been limited to outstanding features, it gives an indication of the validity of the claim that a great diversity of products and processes is being economically carried out in the new Lilly manufacturing building. It is evident that an interesting psychology of chemical engineering production has been cultivated and successfully developed. Those engaged in other process industries in which the diversity factor is assuming difficult proportions, will do well to examine the Lilly system and adapt its features to the solution of their own problems.

Perfect Optical Glass Disk Annealed Nine Months

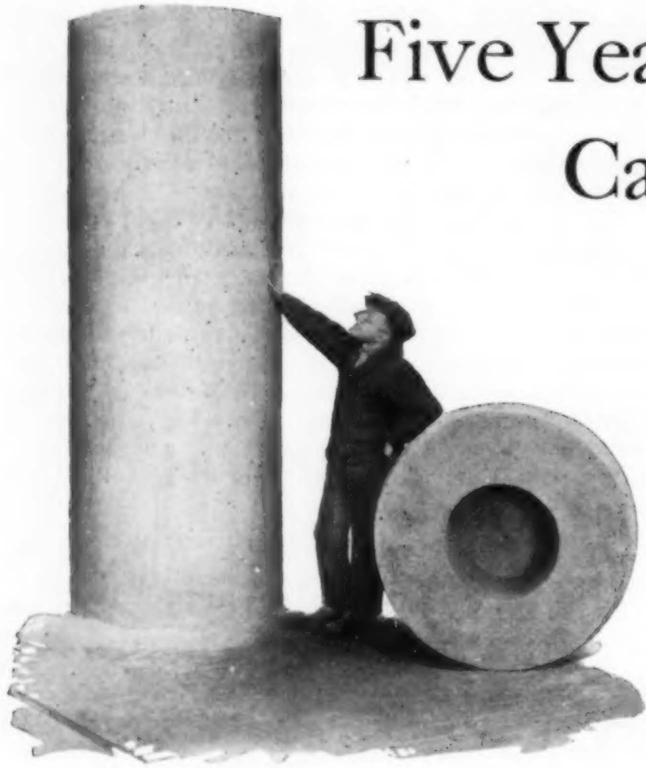
AFTER A PERIOD of over nine months during which the temperature was lowered under absolute control from the casting temperature of 2,400 deg. F. to room temperature, one of the three largest glass castings ever made was uncovered in its annealing mold at the Bureau of Standards. The casting is 70 in. in diameter, 11 in. thick and weighs 3,500 lb.

It is the largest glass casting ever made in this country and is believed to be the only one of its size without flaw which has ever been produced. The casting is to be used for the concave mirror for the new reflecting telescope of the Perkins Observatory at Ohio Wesleyan University.

No American manufacturers were found who were willing to guarantee delivery on a disk of the required size. The problem was turned over to A. N. Finn, head of the glass section of the Bureau of Standards. A special mold was constructed which, at the same time, was insulated and provided with electrical heating elements with which the cooling could be controlled within a degree. The batch, consisting of approximately 5,600 lbs. of borosilicate crown glass, was cast on May 7, 1927. After an accurately controlled cooling cycle the disk was finally uncovered on January 16.



Bureau of Standards' Electrically Heated Annealing Mold in Which the Disk of Optical Glass Was Cast



A 40-Inch Carbon Electrode: One of the Largest Made

Five Years' Progress in Carbon Electrode Technology

By C. L. Mantell

Consulting Engineer, Pratt Institute, Brooklyn

Editor's Note. *In 1922 Dr. Mantell contributed a series of five articles on the technology of the carbon electrode industry. (See* Chem. & Met., *Vol. 27, pages* 109-112, 161-167, 205-210, 258-264 *and* 312-318.) *The series attracted wide attention not only in this country but abroad. The articles were translated into Russian by the Soviet Government and were widely distributed in pamphlet form. The author now brings his discussion up-to-date in the following brief review of technology during the past five years.*

PROGRESS in carbon electrode technology in the last half decade has been the result of new demands made on the industry, the adaptation of processes in new plants to changed practices of the consuming industries, new economic conditions and commercial developments.

The raw materials for electrode manufacture have changed little during this period. Anthracite remains the most important raw material for electric furnace electrodes; petroleum coke for so-called "aluminum" electrodes. American practice continues to use pitches as binders in contradistinction to the Continental employment of pitches and tars.

OF THE various steps in electrode manufacture—viz., (1) selection of raw materials, (2) calcination, (3) grinding, (4) mixing and shaping, (5) baking and (6) finishing and machining—it is in calcination that the greatest advances have been made. Electric calcination, as a result of the higher temperatures reached, produced a coke of lower resistivity than did gas-fired calciners. The greater conductance is due to the greater degree of graphitization produced. At the present time practically all the anthracite used in electrothermal electrodes is electrically calcined. Commercial carbide, ferro alloy and electric steel furnaces are increasing in size; larger electrodes are called for as well as electrodes which allow a greater current input into the furnace. Electrothermal electrodes of lower resistance, which allow the use of higher current densities, are now produced to meet this demand. The tendency is for greater diameters. Five years ago the 24-in. electrode was considered exceptionally large. Todιy 40-in. electrodes are used and sizes up to 45-in. are available on order.

The newest electrode plant is located at a site of unusually cheap power. (See description of electrode plant of the Aluminum Company of America at Arvida, Canada, by R. S. McBride, *Chem. & Met.*, February, 1927, pages 76-83.) The economic situation is such that electric calcination becomes cheaper than gas calcination; a situation which is the reverse of that at older plants. Continuous calciners of the ring electrode type with circulating gas, have been brought to a high stage of development; gases resulting from calcination are recovered and used for boiler fuel and heating purposes. The progress made in continuous electric calcining units has been much greater in the last five years than that of gas calcining ovens. Improved electrode quality results from the use of the lower resistivity products of the electric furnaces.

Formerly the crushing, grinding and pulverizing departments of an electrode plant were likely to contain a sample of every known type of grinding machine. Practice has become more standard as the result of costly experimental work. In those plants making petroleum coke electrodes, greater attention is now paid to "graded aggregates," diligently worked out years ago by the an-

An Installation of Söderburg Electrodes in the Keokuk (Iowa) Plant of the United Lead Company

thracite coal electrode manufacturers. Screening and sizing of dusts now command closer attention. Mixing practice has not changed materially.

The maker of the large-sized electrothermal electrodes now uses extrusion where the user demands that the possibility of electrode chunks falling into his furnace be eliminated. Molded electrodes may crack at right angles to their length; extruded electrodes split parallel to their length. In the newer petroleum coke electrode plants, as a result of plant practice changes, extrusion has been displaced by automatically operated high-speed molding presses. There has been a change from small round electrodes to large square or rectangular blocks. These are more readily molded by present-day machinery.

In all plants, constant endeavor is made to increase the tonnage output per worker by the replacement of men by machinery.

Other than in rearrangement of furnace flues, and design to allow greater ease of flue cleaning, gas baking practice is the same as it was five years ago. Electric baking has displaced gas baking where very low power costs throw the economic balance toward the electric furnace. There has been practically no further development of the electric furnace as byproduct gases are not recovered and sensible heat remaining after baking is wasted. Continuous electric baking furnaces have not as yet appeared. With electric baking, higher temperatures are reached, and lower resistivity carbons are produced.

Furnace manufacturers are eliminating electrode designs which necessitate shut downs for electrode changes. Continuous feed of electrode has become standard practice; the manner of joining electrodes has been reduced to two methods. The first method employs electrodes turned down, and threaded at one end; drilled, and tapped at the other end. These can be fitted together as male and female joints. The second method calls for both ends of the electrode to be drilled and tapped; a small threaded pin serves as the connecting medium.

The molded dowel pin, made into its final form in a single pressing operation in the "green" and then baked, has almost passed out of the picture.

Present-day dowel pins are turned out of stock just large enough to insure good threads. Electrodes are now drilled and threaded in special self-centering lathes the bearings of which are protected from the abrasive carbon dust. Mechanical details on the dowel pins such as an end boss, champering the first thread, reduction of thread tolerances have done away with electrode overhangs. Joint trouble has been reduced to a minimum.

DESIRE for a continuous feed of electrode as it is consumed, has brought the development of the Söderberg electrode. In this method electrode paste (the "green" mix) is tamped into a shell which is a vertical continuation of the electrode holder. As the electrode is consumed the tamped mix passes through zones of increasing temperature up to a heating ring where baking takes place. The electrode is continuous in that the form is kept filled up with electrode paste. It is jointless, baked and renewed right in the furnace.

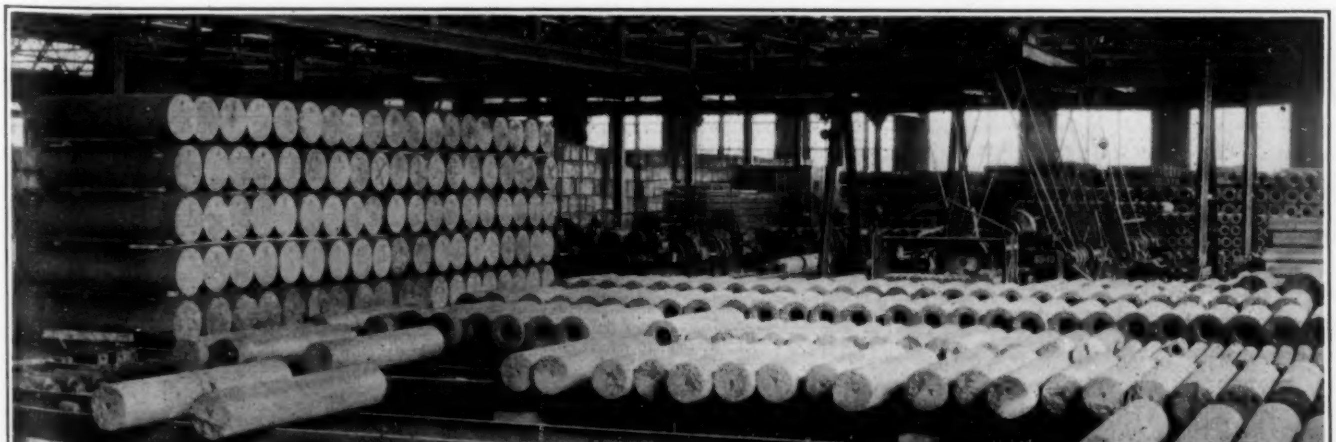
Modern electric steel furnaces are becoming higher powered. The electrode losses then become of extreme importance. Consequently electrode manufacturers are endeavoring to bring electrode resistivity to as low a figure as possible. Sulphur contaminations of electric steel by sulphur from the electrodes has caused the development of electrodes of greater purity, made from selected low sulphur coals and petroleum cokes.

American graphite manufacturers have discarded the joining of electrodes whereby one end is threaded and the other drilled and tapped. This method has been replaced entirely by the nipple or dowel pin joint. Graphite electrodes, due to the accuracy to which they can be machined, require no joint paste. Graphite electrodes instead of costing three to four times as much as amorphous electrodes, as was formerly the case, now cost two to two and a half times as much.

European practice in electrolytic work has almost entirely replaced amorphous carbon anodes with those of graphite. Despite advances by European makers, Acheson graphite is still superior, to judge from the statement of European consumers of the product. American practice standardized on graphite many years ago.

By far the most important indication of progress in the carbon electrode industry has been the spreading of technical information and the lifting of the veil of secrecy surrounding operations. In 1922 *Chem. & Met.* criticized the industry as a 'black art" not only because of the physical dirtiness of the plant but also because of the mystery that surrounded electrode manufacture. This is no longer true. Carbon plants are no longer regarded as fortifications; visitors, even if they come from competitive plants, are often welcomed.

For the use of the photographs illustrating this article, the writer wishes to acknowledge his indebtedness to Thomas F. Wettstein, manager of the Keokuk plant of the United Lead Company and to Frank J. Vosburgh of the electrode sales department of the National Carbon Company.



Threading and Inspection Department of the Niagara Works of the National Carbon Company

Mullite Refractories Extend Field of High Temperature Processes

By W. A. Koehler

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PRESENT day high-temperature operations in many furnace processes have put a great burden on refractories. Many processes are not operated at higher temperatures simply because satisfactory refractories have not been available; in other cases artificial cooling of the refractories permits the use of high temperatures, but with low efficiencies. This has brought about the demand for a so-called "super-refractory." The producers and users of refractory materials have always been eager for information about anything new in refractories. The glass manufacturers have been especially interested since, for chemical reasons, they were dependent on fireclay tank blocks. With increased demand on tank furnaces, in temperature as well as in tonnage, the life of the blocks has decreased in some cases at an alarming rate.

The only outstanding development in new refractory materials in almost a quarter of a century is the industrial application of sillimanite, or more correctly, its decomposition product, mullite.

There are three somewhat closely related aluminosilicate minerals, sillimanite, andalusite, and cyanite, all of the chemical composition $Al_2O_3.SiO_2$. Although alike chemically they differ in their physical properties Until recently it was thought that when andalusite and cyanite were heated to high temperatures they were converted to sillimanite. Bowen and Greig [*J. Wash. Acad. of Soci.*, vol. 14, page 183 (1924), and *J. Amer. Cer. Soc.*, vol. 7, pages 238-54 (1924)], however, have shown that sillimanite itself is not stable above 1,545 deg. C., and that all three of these minerals when heated sufficiently high change into a substance of a different chemical composition: $3Al_2O_3 \cdot 2SiO_2$:

$$3(Al_2O_3 \cdot SiO_2) = 3Al_2O_3 \cdot 2SiO_2 + SiO_2.$$

They named this material mullite, from its occurrence on the Island of Mull. The excess SiO_2 appears as a highly siliceous glass, in which are dissolved small amounts of impurities found in the natural mineral, such as lime, magnesia, and alkalies. This glass bonds the crystals of mullite into a firm mass, and if fairly pure, imparts to the whole the low coefficient of expansion so characteristic of fused quartz, and so desirable in refractory materials. It is largely for this reason that mullite refractories have such a high resistance to spalling.

Table I shows some of the properties of the trimorphic minerals and of mullite. It will be noted how closely the properties of sillimanite resemble those of mullite. The properties are so nearly alike that the existance of mullite escaped notice as long as the study of this group of minerals was confined to the usual physical measurements. Bowen and Greig have also found that mullite will dissolve small amounts of iron and titanium and thereby have its physical properties changed in such a way that it is practically indistinguishable from sillimanite by optical means. It is also interesting to note that the X-ray diffraction pattern for sillimanite and mullite is identical as found by Shearer [*Trans. Ceram. Soc.*, vol. 22, page 106 (1923), Wyckoff [reported by Bowen and Greig, *J. Amer. Cer. Soc.*, vol. 7, page 253 (1924)], and Norton [*J. Amer. Cer. Soc.*, vol. 8, pages 401-6 (1925)]. This appears to be the first case on record in which two different compounds give identical X-ray patterns. Since the work of these investigators, however, Hyslop and Rooksly [*J. Soc. Glass Tech.*, vol. 10, pages 412-16 (1926)] report that they have differentiated between the patterns of mullite and sillimanite.

It was only after the phase diagram of the system $Al_2O_3 \cdot SiO_2$ had been prepared that the identity of mullite was recognized. However, the desirable properties

Table I. Physical Properties of Mullite and Related Minerals

Mineral	Crystalline Structure	Index of Refraction	Prism angle $110 \wedge 1\overline{1}0$	Specific gravity	Volume increase on conversion to Mullite and glass	Decomposition (e) temperature
Andalusite	Orthorombic	$\alpha = 1.632$ (b) $\gamma = 1.643$	89 deg. 12 min. (b)	3.16–3.20 (b)	Very small	Cone 13 (d) (1390 deg. C.)
Sillimanite	Orthorombic	$\alpha = 1.657$ (a) $\gamma = 1.677$	88 deg. 15 min. (a)	3.23–3.24 (b)	Greater than andalusite	Cone 20 (d) (1530 deg. C.)
Cyanite	Triclinic			3.56–3.67 (b)	Greater than sillimanite	Cone 12 (d) (1370 deg. C.)
Mullite	Orthorombic (a)	α 1.612 (a) γ=654	89 deg. 13 min.(a)	3.156 (c)		Begins to melt at 1810 deg. C.

a. Bowen and Greig, *J. Amer. Ceram. Soc.*, vol. 7, page 246 (1924).
b. Dana (Ford) "A Text-Book of Mineralogy," 1922.
c. Greig, *J. Amer. Ceram. Soc.*, vol. 8, page 481 (1925).
d. Peck, *J. Amer. Ceram. Soc.*, vol. 8, pages 423–24 (1925).
e. These temperatures are approximate. Compare the statement by Greig (c) p. 483: "For all three there is no definite temperature at which the minera decomposes sharply to the new phases, and below which it remains unaffected for an indefinitely long period."

of mullite in fired clay wares were long known, although it was mistaken for sillimanite. Some investigators had recognized some of the slight differences between physical properties of natural sillimanite and of that which develops in fired clay bodies (mullite), and called the latter "artificial sillimanite." This term was used freely in the literature before the discovery by Bowen and Greig, and is used by some present-day writers. Mullite has since been found in natural deposits, and the coining of this word avoids the awkward expression, "naturally occurring artificial sillimanite." If any extensive deposits of mullite should be discovered, the terms "natural mullite" and "artificial mullite" may come into use.

ANDALUSITE, sillimanite and cyanite, when heated, change spontaneously into mullite. The temperature at which this conversion takes place is dependent upon the nature of the mineral and upon the kind and extent of impurities present. The conversion temperatures of Peck [*J. Amer. Cer. Soc.*, vol. 8, pages 407-29 (1925)] shown in Table I represent the conversion temperatures of fairly pure minerals. Greig [*J. Amer. Cer. Soc.*, vol. 8, pages 465-82 (1925)] reports that cyanite and andalusite decompose into mullite and silica over a considerable range of temperature, the rate increasing rapidly with increase in temperature.

All three minerals expand during the decomposition. Cyanite expands very much on conversion to mullite and glass, so much so, that it must be calcined before it can be made into refractory shapes, because the expansion is sufficient to shatter the ware on firing. However, Freed [*J. Amer. Cer. Soc.*, vol 9, pages 249-56 (1926)] found that pieces of cyanite three to five inches in diameter and fired to 1,450 deg. C., were wholly converted to mullite and glass, and did not produce a friable, fragile mass, although there was great expansion. Sillimanite expands less than cyanite, but some refractory manufacturers prefer to calcine it in order to produce a sound dense brick. Andalusite expands only slightly and requires no pre-calcination. Twells [*J. Amer. Ceram. Soc.*, vol. 8, page 486 (1925)] reports that it is possible to refit exactly the jagged edges of two halves of a piece of andalusite, one-half unfired, the other half fired to cone 18 (1,490 deg. C.).

The structure of the mullite crystals formed is also different for the different minerals. Greig found that the mullite from cyanite is in tiny bundles of parallel needles varying from about 0.002 to 0.035 mm. in length, the bundles themselves being nearly parallel to one another. The needles begin at the surface and advance into the cyanite. In the conversion of andalusite, the mullite also commences to develop at the surface of the grains and grows inward with the c' axis of the mullite, parallel to the c' axis of the original andalusite. In sillimanite, the growth of the mullite crystals does not start at the surface of the grains, but takes place throughout the grains. The effect of these various crystal orientations on the properties of the finished refractories is still somewhat uncertain.

Cyanite should be calcined at a temperature above 1,370 deg. C. before being made into refractory shapes, in order to convert the mineral into mullite and glass. It need be held at this temperature only a few minutes, unless the lumps are excessively large. This can be done on the lump mineral in any type of refractory kiln, for example, in a periodic down-draft kiln, a car tunnel kiln, or in a specially designed oven or converter. On account of the expansion of the cyanite during conversion, many cracks develop in the lumps which render the subsequent grinding less difficult. Sillimanite has a much smaller expansion during conversion, and for ordinary refractory use the necessity for calcination is questionable. Andalusite requires no precalcination for general refractory use.

The Vitrefrax Company of Los Angeles calcines its mineral at a very high temperature in order to produce a dense, firm brick. The company has built a special natural gas converter in which the mineral is fired to 1,800 deg. C.

The calcined or uncalcined material is usually ground to 40-mesh and finer, mixed with clay or some other bond, and formed into shapes. For clay bond, a plastic kaolin is quite satisfactory when used in quantities of from 7 to 25 per cent. The Vitrefrax Company, prepares an "artificial clay" by grinding part of the mullite very finely and adding a bacterial organic compound, producing thereby a body akin to a moderately plastic clay. Twenty per cent of this is mixed with 80 per cent of mullite.

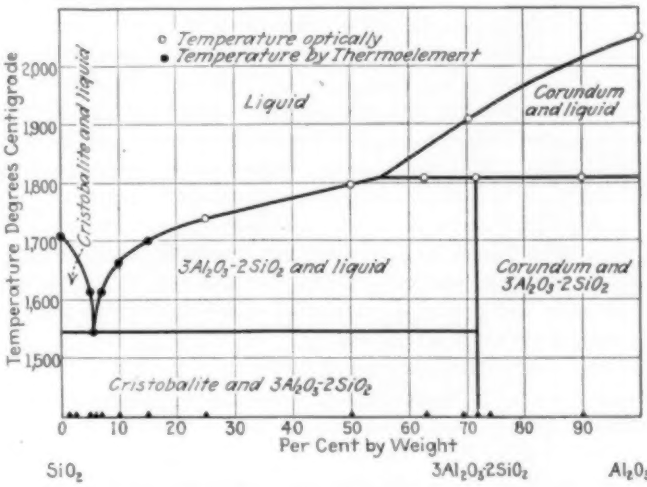

Fig. 1—Equilibrium Diagram of the System: Al_2O_3 SiO_2. (By Bowen and Greig, Geophysical Laboratory, Washington, D. C.).

Several manufacturers are making mullite bricks without a foreign bond, depending upon a recrystallization of the mullite grains to knit the shapes into firm units. Such shapes are burned at a temperature above that of the original calcination, one manufacturer running his tunnel kilns above 1,650 deg. C. Such recrystallized mullite refractories are of very high strength.

ONE of the most recent advances in the manufacture of mullite refractories is the casting of blocks and other shapes from the melted material. This is a development of the Corning Glass Works under the direction of Dr. G. S. Fulcher. The raw material for the cast blocks is said to consist chiefly of diaspore or bauxite mixed with more or less fireclay or kaolin. The mixture is melted at about 1,900 deg. C. in an electric arc furnace mounted on trunnions to permit tilting the furnace so that the melt can be poured into molds. The molds are made of glass sand, baked with a binder such as linseed oil. For rectangular blocks, the molds are made of six slabs, one for each face, the top slab having a hole for pouring. The mold slabs are cemented together with mold paste and supported by an iron frame. It is important that the freshly cast blocks be cooled slowly to

prevent cracking. The large castings are insulated with Sil-o-cel powder, but small castings must be placed in kilns or furnaces to anneal. A 12x12x24-in. block will require about eight days for annealing, hence only about ten days are required for the manufacture of the large blocks from the raw material to the finished product.

The blocks must be cast to desired dimensions, since because of their great hardness, chipping is impossible and grinding is expensive. The various shapes required for walls, bottoms, throats, dog-houses, noses, etc., are cast directly.

The cast blocks have a specific gravity of about 3 to 3.1, giving a weight of about 185 lb. per cu.ft. Under the microscope they are seen to consist largely of mullite and corundum crystals embedded in a glassy matrix which forms from 5 to 10 per cent of the volume of the blocks. They contain a few pores, but these form only 2 or 3 per cent of the volume and are unconnected. Hence the porosity is practically zero. The blocks are laid without mortar, for they can be cast with flat faces which are so square and true that the seams are sufficiently tight. The rate of corrosion of the cast blocks is only about one third that of clay flux blocks and is also considerably less than that of sintered mullite blocks.

The cast blocks are to be manufactured in a new plant built at Louisville, Ky., by the Corhart Refractories Company, recently incorporated by the Corning Glass Works and the Hartford Empire Company. It is expected that this plant will begin production during February.

STANDARD A.S.T.M. tests are not sufficiently severe for the best quality mullite refractories. Scattered reports on the physical properties of mullite refractories give the following information:

Load test: Brick heated at 1,450 deg. C. for 1½ hours under a load of 50 lb. per sq. in. showed no measurable deformation.

Slag Test: There should be no slag penetration on bricks made from finely ground material molded under high pressure. The slag deposit may be broken from the brick with a clean separation. Slag penetrates readily if bricks have a high porosity.

Spalling Test: From a temperature of 850 deg. C. well made bricks have withstood over 70 quenchings in cold water without loss.

Thermal Expansion: The coefficient of expansion is 0.0000056 between 20 deg. and 1,000 deg. C. according to Freed (loc.cit.).

Softening Point: Above cone 36 (1,850 deg. C.).

Refractoriness: Pure mullite begins to melt at 1,810 deg. C. forming corundum and liquid. Mullite made from the $Al_2O_3 \cdot SiO_2$ mineral contains 87.64 per cent mullite and 12.36 per cent silica, which according to Fig. 1, forms the first liquid at 1,545 deg. C., and as the temperature increases, progressively more liquid is formed, consisting of mullite dissolved in silica. If sufficient alumina is added to the $Al_2O_3 \cdot SiO_2$ mineral (32 lb. alumina to 100 lb. mineral) so that the equation

$$3(Al_2O_3 \cdot SiO_2) = 3Al_2O_3 \cdot 2SiO_2 + SiO_2$$

becomes:

$2(Al_2O_3 \cdot SiO_2) + Al_2O_3 = 3Al_2O_3 \cdot 2SiO_2$, then a 100 per cent mullite refractory would be obtained, in which no liquid would be formed below 1,810 deg. C. If the alumina added were in excess of this amount, the softening point would not be lowered. It would therefore be theoretically desirable to add extra alumina in order to bring about increased refractoriness. The practical value of this in bonded bricks is still uncertain. In the first place, the liquid formed at 1,545 deg. C. is highly dispersed among the mullite crystals, and in the second place, it is nearly pure silica and has therefore a high viscosity so that the refractoriness of the mullite is but slightly impaired. If alumina is added, it does not react readily with the highly viscous silica, so that it is necessary to add some fluxing material (e.g., magnesia up to 3 per cent, but since the flux itself decreases the refractoriness, it is doubtful if much is gained by this combination. Harrison [*J. Amer. Cer. Soc.*, vol. 9, pages 257-71 (1926)], and McCaughey [*J. Amer. Cer. Soc.*, vol. 9, pages 271-27 (1926)] are studying this phase but their results have not yet been published. Pure alumina is too expensive to be used for this work; bauxite and diaspore clays seem most promising.

Mullite refractories may be made by fusing alumina and silica bearing minerals in an electric furnace, or by heating clayey materials at their maturing temperatures, though the mullite content of refractories made by the latter method may be very low. Thus mullite can readily be made artificially, and any attempts to produce any of the $Al_2O_3 \cdot SiO_2$ minerals artificially has always resulted in the production of mullite.

Another mineral, dumortierite, closely related to the sillimanite group, has the formula $8Al_2O_3 \cdot 7SiO_2 \cdot B_2O_3 \cdot H_2O$. The alumino-silica ratio is closer to mullite than that of the $Al_2O_3 \cdot SiO_2$ minerals. It can be converted to mullite below 1,250 deg. C. and can therefore be incorporated in white ware bodies without precalcination. It is found in Nevada in a deposit several feet wide, several hundred feet long and of unknown depth. It is mixed with andalusite in the manufacture of spark plug cores by the Champion Porcelain Company.

MULLITE refractories can be used practically wherever fire-clay refractories are used. However, it is not likely that they will displace fire-clay refractories except in cases where the latter are subjected to severe conditions.

The big field for mullite refractories at present is in the glass industry. With the introduction of glass blowing machinery, glass tanks are operated at higher temperatures and at faster rates, so that the industry has been facing the problem of decreasing tank block life. Glass house refractories that come in contact with the molten glass have generally been limited to fire-clay, or in special cases to porcelain, but mullite appears as a very promising material. In a glass tank under heavy duty the tank must be relined every ten to fifteen months, while under similar conditions mullite blocks have served three years and are still in service. For best service, the lower part of the tank, to just above the flux line, should be made of recrystallized or cast mullite blocks, but the superstructure, although also of mullite, may be built of molded blocks.

Besides glass tank blocks, other fields for mullite refractories are glass pots, enamel furnaces, electric furnaces, muffles, piers, checkers in water gas carbureters and any parts of furnaces subjected to high temperatures, especially where high rigidity and non-shrinking and spalling characteristics are very desirable.

Unfortunately, the nomenclature relating to mullite refractories is very confused. Manufacturers vary in naming their products from the raw and the finished material.

Synthetic Ammonia Costs in America

By R. S. Tour

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IN THE COMMERCIAL development stage of any industry, the important consideration must always be costs. Will the investment at some future time, not necessarily at once, be repaid with prope.· return? To interest capital in industrial development, the answer must be in the affirmative. Promotion or propaganda offering a glowing affirmative answer but leading to disappointing experience may do much to hinder the best development of any industry. Nitrogen fixation in America now is at that stage where great care must be exercised in the propaganda aimed to build the business. Some plants have already been disappointments; how great, no one may ever know.

Capital, seeking investment in nitrogen fixation and desiring an answer to the question of costs, must consider not only the investment and production costs, but also the sales and distribution expense, as well as the market price of the product and how the latter may be affected by increased supply. This paper is to discuss only the investment and the production costs for the direct synthesis of ammonia, with a serious attempt at impartiality and with great care to avoid the omission of any pertinent items or considerations.

FOR THE purposes of cost estimating in this paper, the synthetic ammonia process may be logically subdivided into two distinct modifications, respectively distinguished by the source of hydrogen for synthesis and called for convenience (1) Water-gas synthetic ammonia, and (2) Electrolytic synthetic ammonia. The costs of the plants and their operation will be estimated for the production of ammonia gas as the end product. This permits a logical basis for comparison of ammonia synthesis costs. Although the ammonia produced by any large scale nitrogen fixation plant will have to be marketed as an ammonia compound (such as sulphate or phosphate), nevertheless, such steps are obviously independent of the process for nitrogen fixation and will not be included in this consideration of costs.

The fundamentals of the process have been described quite thoroughly in the literature of the past several years [R. S. Tour, *J. Ind. Eng. Chem.*, vol. 12, p. 844 (1920)] and will not be detailed at this time. However, the process suffers from a multiplicity of variations, often dignified by titles as distinct processes. As the commercial development of ammonia synthesis progresses, experience eliminates many variations. Practical experience and engineering judgment must serve to define the proper steps of the process to be adopted for any given plant. Without entering into a discussion of the relative merits of the steps, the following are the proposed processes to be considered in this paper.

The gas production steps selected for water-gas synthetic ammonia are essentially the same as in the Bosch process of the German plants, thoroughly described as to type of equipment and process in a previous paper [R. S. Tour, *Chem. & Met.*, vol. 26, Nos. 6, 7, 8, 9 and 10, (1922)]. The deviations from the Bosch process consist mainly in (*a*) carbon dioxide removal at 45 atmospheres pressure rather than 25 atmospheres, (*b*) purification and synthesis at 250 atmospheres instead of 200, (*c*) final carbon dioxide removal by caustic solution preceding copper solution scrubbing, (*d*) additional purification (drying, etc.) following the copper solution scrubbing.

The ammonia synthesis and removal portion of the process (circulating system) is shown in Fig. 1. These steps are common to both the water-gas hydrogen and electrolytic hydrogen modifications of the process here considered. For producing ammonia gas rather than aqua ammonia, the steps shown in Fig. 1 differ materially from the Bosch process referred to above.

The electrolytic production of hydrogen and the air-liquefaction production of nitrogen are the proposed steps for the electrolytic process and are sufficiently direct and simple as to require no discussion.

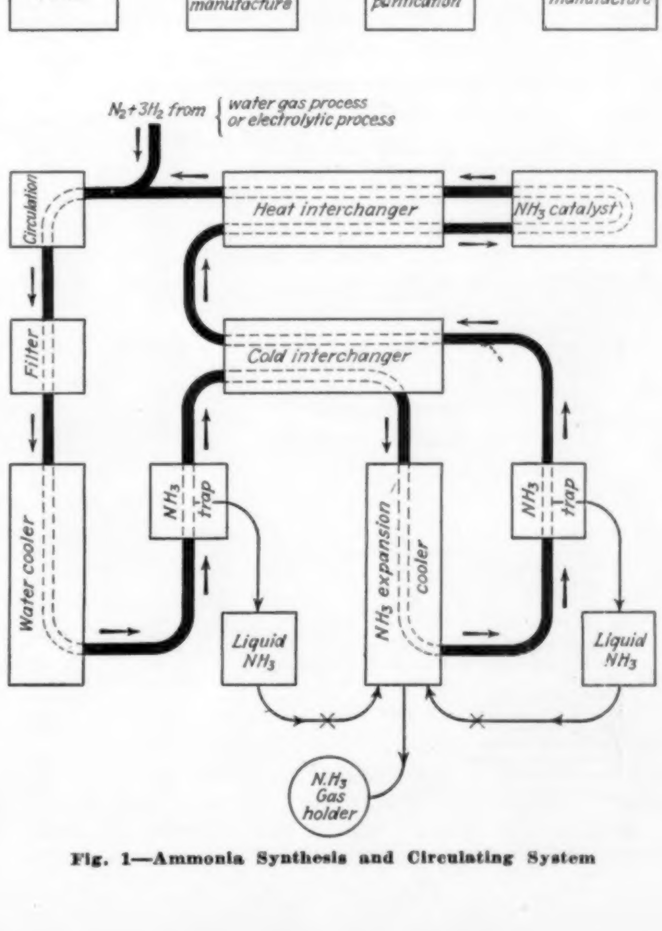

Fig. 1—Ammonia Synthesis and Circulating System

This article is an abbreviation of a paper presented in full at the meeting of the American Institute of Chemical Engineers, St. Louis, December 5-8, 1927. Prints of the complete paper may be obtained from *Chem. & Met.* or from the author.

IN VIEW of the current and ever-present Muscle Shoals discussion in the United States, the costs in this paper will be developed for plants with sufficient capacity to continuously produce 40,000 net tons (2,000 lb.) of fixed nitrogen annually. For this purpose, a rated capacity of 6 net tons of ammonia per hour has been allowed, calling for an average load factor throughout the plant of 92.5 per cent. This does not presume that unity load factor or even overload operation cannot be obtained, but only that, with optimum efficiencies, a 6-ton-per-hour ammonia plant is expected to deliver annually 40,000 tons of fixed nitrogen. With equipment properly rated as to capacity, a 92.5 per cent yearly operating or load factor is no mean figure for any manufacturing plant to strive for.

The selection, design, or costing of equipment for any plant requires specific data on the quantities of all materials and intermediate products to be handled throughout that plant. These will, of course, depend on the size of plant being considered, the process steps being used, and the efficiencies expected at each step. The size of plant has already been defined, viz., 6 tons of ammonia per hour; the steps of the process have been selected earlier in this paper; and the efficiencies expected must accord with experience and present practice. Based on all the above, there follows a tabulation of some of the operating quantities in process, calculated per net ton of dry ammonia gas.

THE FOLLOWING estimates of the present-day cost of construction of synthetic ammonia plants are offered in as much detail as is consistent with the purposes of this paper. The tabulation for each process is arranged to show the direct costs of each department of the plant. All totals given are for complete installations amply housed and designed for a continuous rated capacity of six tons of ammonia per hour. Where necessary, spare equipment is included to insure continuous operation.

For the synthetic ammonia plants (water-gas and electrolytic), the compression, purification, ammonia synthesis, and ammonia removal portions of the plants are laid out with six distinct operating units of equipment, each with a capacity of one ton of ammonia per hour, since this capacity is the largest that present-day experience deems safe or feasible. These six units of equipment are tied together with "ring mains" and, where necessary, a seventh unit is installed as a spare. To arrive at a correct figure for the plant cost, it was necessary to list all equipment, roughly design those items which were not standard, and apply present-day standards of cost to all. The figures in Table II are summaries of detailed costs of equipment and buildings.

The plant "delivery and construction" charges allowed on all units of equipment in each process have been in accordance with one of the three tabulations following, depending on the classification of such equipment.

	Charges Allowed—Per Cent I	II	III
Engineering and design including inspection and purchasing	3	5	7
Freight	3	2½	2
Hauling and handling	1	1½	2
Foundations and settings	5	4	3
Installation and erection (with wiring, piping, etc.)	10	15	20
Totals (per cent)	22	28	34

Construction charges I above are applicable to standard equipment not requiring highly special design or unusual erection facilities, e.g., steam boilers, water-gas machines and rotary converters. Charges II are applicable to semi-standard equipment specially designed or developed for the processes such as liquid air machines of 1,000 cu.m. per hour capacity, hydrogen compressors of 2,000 cu.ft. per minute displacement to 3,800 lb. pressure. Charges III apply only to the highly specialized equipment of the synthetic ammonia process proper, such as heat interchangers and ammonia catalyzing bombs.

For each main department, a "miscellaneous and contingency" charge of 10, 15, or 20 per cent is allowed depending on the type of equipment and construction involved. This allowance covers the cost of minor items omitted in the estimates, errors in design, and unforeseen requirements, as well as the cost of testing and modifying the equipment after installation. The 10 per cent allowance is for standard equipment and construction. The 15 per cent is allowed for those departments using semi-standard equipment classified under II above and 20 per cent is allowed for the Class III installations.

The charges for delivery and construction at 22 per cent and for miscellaneous and contingencies at 10 per cent for Class I installations (standard) are generally accepted for preliminary cost estimates of plants using standard equipment. Larger percentages must be allowed for Class II (semi-standard) and Class III (special) installations.

Under the general heading of plant facilities are included real estate and rights of way (200 acres); clearing, grading, fencing, roads, walks; railways, rolling stock, trucks, etc.; electrical substation, distribution, lighting; water plant and water supply; sewer system and waste disposal; raw material unloading and handling; warehouses, stock rooms, raw material storage; shops (machine, pipe, wood, etc.) equipped; general office building, central laboratory, equipped; hospital, wash rooms, welfare equipment, etc., and miscellaneous.

TABLE I

Operating Quantities—Synthetic Ammonia Processes
(Per net ton ammonia)

	Water-Gas ammonia	Electrolytic ammonia
I. H_2 and N_2 in process (60 deg. F., 30 in. Hg)	M. cu.ft.	M. cu.ft.
Lost in low pressure system	3	2
Dissolved in water scrubbing	11	......
Lost in high pressure purification	5	1
Lost or purged in ammonia system	12	8
H_2 and N_2 in product	89	89
	120	100
II. Raw Gases (60 deg. F., 30 in. Hg)	M. cu. ft.	M. cu. ft.
Blue water gas plus nitrogen gas	125	......
Nitrogen (as air and/or as pure N_2)	10	25
Electrolytic hydrogen	......	75
III. Catalysts and Special Materials	Lb.	Lb.
Catalyst (NH_3)	3	2
Catalyst (CO)	2	......
Caustic Soda	30	1
Misc. (Copper solution, lime, etc.)	x	x
IV. Steam	M. lb.	M. lb.
CO Conversion (50 per cent interchange)	12	......
Gas manufacture	5	......
Water distillation	......	2
Additional	3	1
	20	3
V. Water	M. cu. ft.	M. cu. ft.
Cooling (Compressors and hot gases)	8	2
Water scrubbing	16	......
Additional	6	3
	30	5
VI. Fuel	Tons	Tons
Coke (for blue gas and lean gas)	2.00	......
Coal (for steam and/or distilled water)	1.30	.30
VII. Power	Kw.-hr.	Kw.-hr.
Electrolytic cells	......	10,200
Liquid air machines, compressed air	100	250
Gas compressors	1,200	800
Hydraulic pumps	750	......
Deoxidation heaters	......	100
Process (Gas house, blowers, pumps)	200	100
General plant and miscellaneous	200	150
	2,450	11,600

It is obvious that the costs to be allowed for plant facilities depend largely on the location of the plant site and the judgment or desire of the engineers in charge. These costs may easily vary from $1,700,000 ($35 per ton ammonia production), as a minimum for electrolytic hydrogen synthetic ammonia, to $5,000,000 ($100 per ton), a high figure but easily exceeded. No generally applicable estimate can be made. The totals allowed for plant facilities in this paper are purposely taken low and presume favorable conditions.

Overhead costs are totaled at 20 per cent as follows: Interest during construction at 5 per cent allows 20 months (at 6 per cent) for the period of construction and getting the plant into operation. Insurance, taxes, damages, legal expense at 2 per cent, and executive, administrative, accounting expense at 3 per cent are accepted allowances but are often forgotten. Contractors' profit at 5 per cent is a minimum allowance and cannot be omitted on the grounds that contractors will not be used, since in such case additional construction equipment must be charged against the plant. Organizing and starting is rightly charged as an overhead plant cost, although it is sometimes considered as an initial deficit in operation. At 5 per cent, this charge allows for an operating loss (probably accruing during the first year) equivalent to about 5 weeks' operation.

TABLE II—PLANT COST SUMMARIES

Production—40,000 tons N_2 or 48,570 tons NH_3 per year

	Cost Totals	Per cent of total	Per annual ton N_2	Per annual ton NH_3
Water-gas ammonia				
Gas manufacture	$3,100,000	22	$77	$64
Compression, purification	3,215,000	23	80	66
Ammonia process	2,875,000	21	72	59
Plant facilities	2,300,000	17	58	48
Physical plant	$11,490,000	83	$287	$237
Overhead costs	2,300,000	17	58	47
Total Plant	$13,790,000	100	$345	$284
Electrolytic hydrogen ammonia				
Gas manufacture	$7,345,000	48	$184	$151
Compression, purification	1,160,000	7	29	24
Ammonia process	2,450,000	16	61	51
Plant facilities	1,800,000	12	45	37
Physical plant	$12,755,000	83	$319	$263
Overhead costs	2,550,000	17	64	52
Total Plant	$15,305,000	100	$383	$315

It must be noted that the final plant costs developed here include no working capital whatever, such as investment in stocks of raw materials, in inventories of repair parts and operating supplies, in seasonal stock of finished product, and in cash on hand. The working capital required will be estimated separately.

IN COMPARING the plant cost estimates offered here with others that may be available, attention must be called to the fact that the estimates in this paper do not omit consideration of the operating load factor to be expected and the spare equipment necessary throughout the plant; nor of the delivery and construction charges as already defined and miscellaneous and contingency costs, both scaled in accordance with the types of equipment involved; nor of all the general plant facilities absolutely essential in a plant operating independently; nor of each of the items listed under overhead costs. The omission of some of the above costs or charges may materially reduce estimated total plant costs. Such omissions may be allowable in individual cases, but the resulting cost estimates cannot then be applied to the general case.

A comparison of first costs of plants for water-gas synthetic ammonia and electrolytic hydrogen synthetic ammonia must take into consideration the size of plant. Obviously, the costs for either plant will go up per annual ton of ammonia with decreased size of plant, but this increase is not so rapid for electrolytic hydrogen as for water-gas plants. Although the former is somewhat more costly in this estimate for a production capacity of 40,000 tons of nitrogen, it becomes the cheaper of the two for small plants.

VERY little need be said relative to the labor costs here tabulated for the operation of the plants. Only continuous operation was considered and, where 24-hour labor was necessary, it was allowed for in three 8-hour shifts. Although detailed payrolls were made up for each of the plants, space does not permit offering such itemized tabulations. Table III gives the labor required for each of the two processes.

Process operation labor includes all men, together with their foremen and departmental superintendents, employed wholly within those departments directly producing the intermediate products or final product of the plant. The tabulation gives sub-totals for the main departments of the process.

General plant labor includes the employees of all supervisory departments, such as managers, general superintendents, plant engineers, chemists, with their respective assistants and staffs, where such are not wholly assigned to and do not report to the authority of particular operating departments; of all clerical departments, such as purchasing, accounting, disbursing, and employment; of all plant utilities including yards and grounds, electrical distribution, water supply, lighting, motor transport, and plant hospital; and of all similar departments essential to but not directly involved in process operation or in plant maintenance.

Plant maintenance labor is for current repairs and renewals and represents a permanent force of skilled and unskilled labor retained to keep the plant in operating condition at all times by making the necessary repairs and installing renewal parts, in so far as such installation costs are not included under depreciation. Labor is not allowed for such repairs or replacements as involve extensive or complete fabrication of equipment. Such labor may be necessary or desirable, but is rightfully charged under depreciation. In comparing the maintenance labor here with that in other ammonia plants, this point must be kept in mind.

TABLE III—LABOR COSTS

Production—40,000 tons N_2 or 48,570 tons NH_3 per year

	Water Gas No.	Water Gas Per ton NH_3	Electrolytic No.	Electrolytic Per ton NH_3
Process operation				
Gas manufacture	178	$5.99	214	$7.02
Compression-purification	94	3.18	27	.89
Ammonia process	152	4.94	143	4.73
Total, process	424	$14.11	384	$12.64
General plant				
Supervisory and control	109	4.30	77	3.25
Clerical and office	78	2.43	66	2.09
Utilities and grounds	113	3.67	104	3.37
Total, general plant	300	$10.40	247	$8.71
Plant maintenance including repairs, current upkeep	270	10.24	231	8.79
Miscellaneous, contingency	99	3.48	86	3.01
Total, plant	1,093	$38.23	948	$33.15

EDITORS' NOTE—*The second and concluding section of this résumé of Dr. Tour's study of synthetic ammonia costs in America will appear in the March issue of Chem. & Met.*

A Method of Fractionating Natural Gasoline

By D. B. Keyes

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TODAY the natural gasoline industry requires a high yield and a high grade product. A low yield and a low grade product, even though produced in immense quantities, cannot command a price sufficient to produce a reasonable gross profit.

Both yield and quality of natural gasoline depend largely upon the degree of fractionation of the crude product. The natural "weathering" process is an excellent example of inefficient fractionation. The low boiling and undesirable hydrocarbons (methane, ethane, and propane) are removed by simple distillation. It is quite evident that this simple distillation will also remove appreciable quantities of the higher boiling and desirable hydrocarbons (butane, pentane, and up). It has been reported that replacing this simple still with a fractionating column once increased the yield 45 per cent.

It is the purpose of this article to show a satisfactory hook-up for the fractionation of natural gasoline.

Fig. 1 gives an idea of the general process. For sake of illustration it is assumed that an absorption process is used. The preheated oil containing the gasoline and the gases enter at the left and pass into a stripping column 1. Merely as a convenience for illustrating this discussion steam is used as a heating medium throughout the process. The oil from the bottom of the columns could be made to pass into a still and the vapors returned to the column, or other indirect heating means could be used if desired.

From the bottom of this column 1 pure absorbing oil and water are withdrawn. The oil is cooled and separated from the water and returned to the system. The vapors from this column consist of all of the gases, all of the product, and a little of the absorbing oil. The first condenser is run warm. Part of this condensate is returned as reflux and part sent on to the fractionation column 2. The second condenser is a cold or total condenser. This condensate, which probably has a different composition than the other, passes on to a separate fractionating column 3. The uncondensed gas will be further treated as described later in this article.

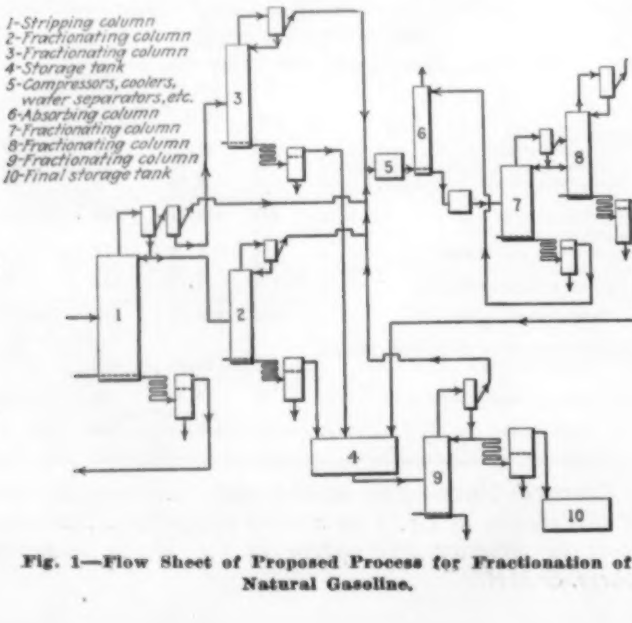


Fig. 1—Flow Sheet of Proposed Process for Fractionation of Natural Gasoline.

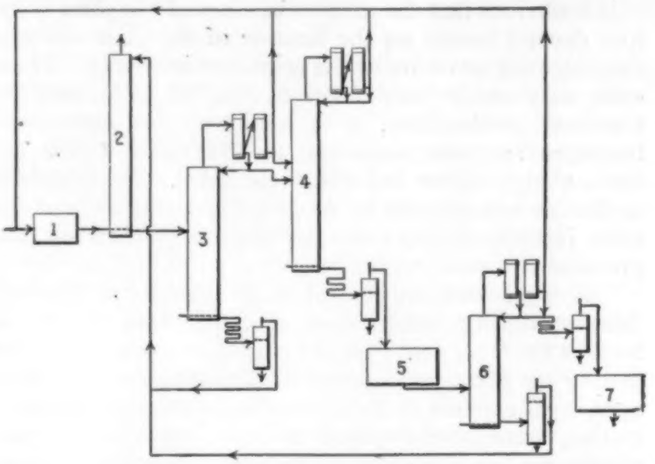


Fig. 2—A Simplified Fractionation Process Based on Scheme Shown in Fig. 1.

It is quite possible to use one fractionating column instead of two as described. The two feeds will, however, enter at different points if they differ in composition.

These fractionating columns act in the customary manner. The product containing a little too much absorbing oil (for the correct end point) is cooled and separated from the water and passed to a storage tank 4. The uncondensed gases from the condensers containing some valuable butane and pentane are sent to the compressors, coolers, and water separators 5 along with the uncondensed gas from the condensers on the stripping column.

A second absorption in the absorbing column 6 then takes place. A lower boiling absorbing oil is used in this case. The unabsorbed gases are sent back to the line. The gas-oil solution is stripped again in the stripping column 7 and the pure absorbing oil returned to the absorber. The crude product is refined in the fractionating column 8. The nearly pure product is sent to the storage tank 4 and the uncondensed gas from the condenser goes back to the line.

The product in the first storage tank 4 will meet the specifications except in perhaps one respect, too high an end point. This is due to the presence of a small amount of absorbing oil, which can be removed as tails in the fractionating column 9. The uncondensed gases go back to compressors, coolers, etc. A fairly large amount of steam will be used in this column as the bulk of the material is distilled. The reverse is true in all other fractionating columns shown. The distillate is cooled, separated from the water, and sent to the storage tank 10.

It should be remembered that the diagrams shown here are merely flow sheets, omitting many details. Stated briefly this method of refining consists of stripping, and fractionation; the heads are recompressed, absorbed, stripped and fractionated; the tails are fractionated further to remove any undesirable high boiling oil.

A simpler and probably less efficient process is illustrated in Fig. 2. The uncondensed gas from the first fractionating column 4 together with the uncondensed gas from the stripping column 3 and from the fractionating column 6 are returned directly to the first compressors, coolers, etc. 1, and then to the first absorber 2 and stripping column 3. In the former case these gases were sent to separate compressors, coolers, absorber, etc. This means the elimination of three columns, a compressor, and auxiliary equipment.

Simplified Calculations in Design of Natural Gasoline Absorbers

By W. K. Lewis

Professor of Chemical Engineering, Massachusetts Institute of Technology

A METHOD of computation[1] of continuous countercurrent absorption systems for the absorption of any single component in a gaseous mixture by a non-volatile liquid absorbent in which the other component or components of the gas are substantially insoluble has recently been developed. This method not only simplifies the computations necessary in the design of equipment and the testing of operating plants but makes it easy to visualize clearly what is taking place in the process. It is the purpose of this article to expand the application of this method of computation to solve the more complicated problems met in the absorption of the large number of components present in natural gasoline.

For the sake of clarity it is desirable to consider first a system in which one is absorbing a single soluble component. Thus, assume a mixture of butane and methane, in which one is dissolving the butane by countercurrent flow of absorbent oil. Express the concentration of butane in the gas as mols of butane per mol of methane, calling this ratio y. Similarly, the concentration of butane in the liquid, x, is expressed as mols of butane per mol of absorbent. Call the mols of methane passing through the absorption system per unit time G, and the mols of absorbent oil L. It will be clear that any butane given up by the gas must be picked up by the liquid, i.e., $Gdy = Ldx$. Integrating, $G(y_0 - y) = L(x_0 - x)$, where the subscript 0 refers to concentration conditions at the rich end of the absorber. This means that the concentration of butane, thus expressed, in the gaseous phase is linear in terms of the corresponding concentration in the liquid phase. This equation, representing as it does the operating conditions which must of necessity obtain at every point in the absorber, may be referred to as the operating line. Since this equation represents nothing but equality of input to output of butane, its validity cannot be questioned if one grants the operating conditions assumed in its derivation. It should be noted that the slope of this line is L/G, the ratio of absorbing liquid to inert gas submitted to treatment. It follows, therefore, that if one knows this liquid-gas ratio, a single point on the operating line determines the operating conditions throughout the absorber.

Since at every point in a continuously operating absorption unit conditions must be such that positive absorption is taking place, it is clear that the operating line must at all points lie on that side of the equilibrium curve corresponding to higher concentrations in the gaseous phase than the equivalent equilibrium concentrations in the liquid phase. Furthermore, the distance between the operating line and the equilibrium curve represents the driving force producing absorption and is therefore a quantitative measure of the rate of absorption in the unit.

[1]Principles of Chemical Engineering, Walker, Lewis and McAdams, second edition, 1927, McGraw-Hill Book Co., Inc., pp. 675 et seq.

In a natural gasoline absorption system one has to deal not with one but with a large number of soluble components. Usually, however, the amount of the methane and other permanent gases dissolved is negligible in comparison with the total amount of these present, though not in comparison with the amount of higher boiling constituents absorbed. Focussing attention for the moment on any one of the soluble constituents, and expressing its concentration in the gas as the ratio of the number of mols of this constituent in the gaseous phase to the number of mols of insoluble gas (methane plus other permanent gases, or, if desired, any one of these) and, similarly, its concentration in the liquid as the ratio of the mols of this constituent to the mols of non-volatile absorbent, it follows that there must exist for this constituent an operating equation, $G(y_0 - y) = L(x_0 - x)$, entirely analogous to the case of a single soluble constituent. As before, this equation represents a straight line. Furthermore, the slope of this line is the ratio of absorbent liquid to inert gas treated, L/G. Finally, there is an equation of this sort for each component dissolved, representing a straight line in each case, and the slopes of all these lines are the same, namely, L/G; i.e., the operating lines for all components are parallel straight lines.

Take for the moment the absorption of a lean gas. Call the partial pressure of the component under consideration p, the vapor pressure of this component in the pure state at the temperature of absorption P, and the operating pressure on the unit π. It is obvious that $p = Px = y(\pi - \Sigma p)$. Granting that Σp is negligible, $y = \left(\frac{P}{\pi}\right) x$. In other words, in this case, the equilibrium curve is a straight line through the origin with the slope P/π. Assuming an operating temperature of 300 deg. K., and an operating pressure of three atmospheres absolute, $P_2 = 43$, $P_3 = 10.3$, $P_4 = 2.63$, and $P_5 = 0.72$, whence the corresponding slopes are 14.3, 3.43, 0.88 and 0.24. The equilibrium lines are shown as full lines on Fig. 1. Assume an initial ethane concentration, expressed as ratio of ethane to permanent gases, of ten per cent, propane of eight per cent, butane of five per cent and pentane of two per cent. Assume furthermore that the absorber is so designed and operated as to dissolve half the butane, using an amount of absorber oil such that the rich oil leaving the absorber is 90 per cent saturated with butane. This determines the butane operating line, shown as a dotted line in the figure. Its left hand end must lie at 2.5 per cent, since this is half the butane in the original gas. Its right-hand end must lie at $x = 5.1$ per cent, since at the butane concentration in the rich gas equilibrium with the liquid would correspond to 5.7 per cent. It will be noted that the driving force causing absorption of butane is large at the lean end of the diagram and small at the rich end. Remem-

bering that in the case of each component, the average distance between its operating line and equilibrium line (the driving force) times the effective area of inter-phase contact times the coefficient of absorption must equal the amount absorbed, it will be clear that in taking the ratio of these expressions for any two components the contact area drops out and consequently when the operating line for any one component is determined, those for all others are all fixed. Thus, in Fig. 1 the operating line for ethane must be parallel to that for butane and must lie entirely to the left of the ethane equilibrium. Obviously, therefore, it must be the dotted line shown for ethane and its right-hand end must, so far as ethane is concerned, correspond to substantial equilibrium between liquid and gas at the rich end of the absorber. Practically, the same is true for the propane operating line, though here, because more propane is dissolved, the right-hand end will not come quite so close to the equilibrium curve. It should be noted that in both these cases the driving force is small at the rich end of the absorber and large at the lean. When, however, one comes to pentane the situation reverses. Remembering that the pentane operating line must be parallel to the others, and yet lie to the left of the pentane equilibrium, it is obvious that this line must be one corresponding to quite complete absorption of pentane from the gas, as shown by the dotted line on the diagram. Furthermore, it is impossible for the pentane to be anywhere near equilibrium in the two phases at the rich end of the system. In other words, for high boiling constituents the driving force becomes very large at the rich end of the diagram but very small at the lean end. This is why it is so difficult to remove completely the high boiling, very soluble constituents from the gas by liquid absorption, despite their solubility. None the less, the less their volatility and consequently the flatter their equilibrium line, the greater the driving force at the rich end and the more nearly completely are they absorbed, i.e., in such cases the operating line starts just above the origin but very close to it.

Where one is dealing with a lean gas it is possible at low pressure to establish an equilibrium curve for each component in the system, as has just been done. Where the gas is rich or the pressure high, so that one builds up a high concentration of dissolved constituents in the absorbent liquid, the equilibrium for each component is not a function of the characteristics of that component alone but is influenced by the character and amount of the other soluble components. But at the lean end of the system the equilibrium conditions remain identically those of the preceding case and this disturbing factor becomes effective only at the rich end. In other words, for each component the equilibrium curve starts out at the lean end from the origin with the slope given in the preceding case but the equilibrium begins to deviate from this as concentrations go up. However, the extent of the

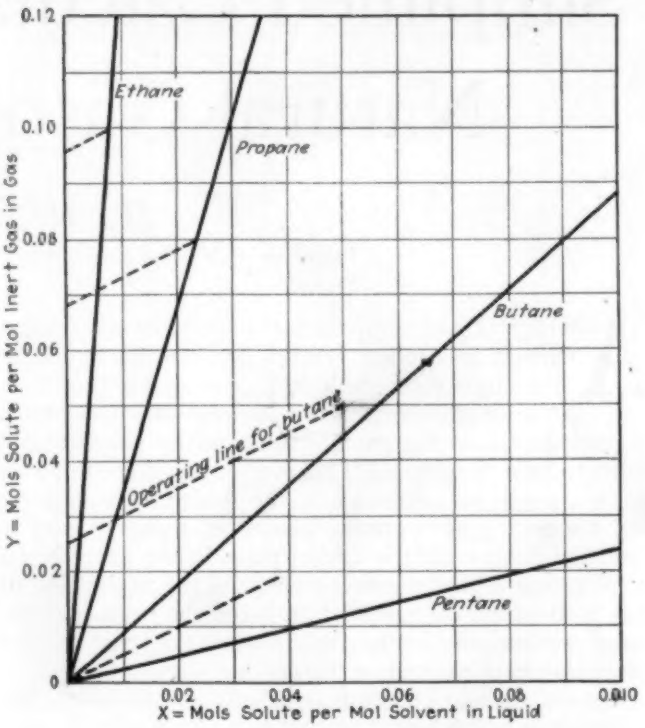


Fig. 1

deviation for each component depends only on the total number of mols of all components dissolved per mol of the absorbing liquid and in any given case this quantity can be estimated in advance with a reasonable degree of precision. This determines one point at the rich end of the equilibrium diagram for each component. Considering that the equilibrium diagram must start at the origin with a fixed slope and must go through one point the location of which is known, the curve can be drawn in with a reasonable degree of precision.

The relationships will best be understood by consideration of data obtained in a test on an operating plant. The effective temperature at the bottom of the absorber was 308 deg. K., and the operating pressure 3.18 atmospheres absolute. The composition of the raw gas is given in the first column of figures in the table below. The partial pressures calculated from these data are given in the second column. The fourth column is the theoretical concentration of each component in the liquid absorbent on the assumption of equilibrium between effluent rich absorbent and incoming rich gas, calculated from the relation $p = Px$. The fifth column of figures shows the composition of the rich absorption stock as actually realized in this particular plant, expressed in mol per cent. This last quantity, divided by the preceding one for each component, gives the per cent saturation of that component in the absorbent liquid. The mol per cent of absorbent oil in this rich effluent liquid was 82.1. It will be noted that for the first four volatile components

TABLE I

Component	Raw gas composition	p(atm.)	P	Mol % (calc.)	Mol % (actually in liquid)	% saturation	Entering raw gas (CH_4 + basis)	Exit raw gas (CH_4 + basis)	Mols per mo G.O. at equilibrium
CH_4 +	68.5	2.179	.....	.....	1.0	.....	.....	.....	.....
C_2H_6	11.9	0.378	51.	0.74	0.7	95	17.4	17.0	0.89
C_3H_8	10.0	0.318	12.7	2.5	2.15	86	14.6	13.4	3.0
Iso-butane	1.8	0.057	5.0	1.14	1.15	101	2.6	2.0	1.37
Butane	4.2	0.134	3.4	3.94	3.7	94	6.1	4.0	4.74
C_5H_{12}	2.1	0.067	0.95	7.0	4.1	59	3.1	0.9	8.4
C_6H_{14} +	1.5	0.047	0.097	49.0	4.1	8	2.2	.....	59.0
	100.0				16.9				

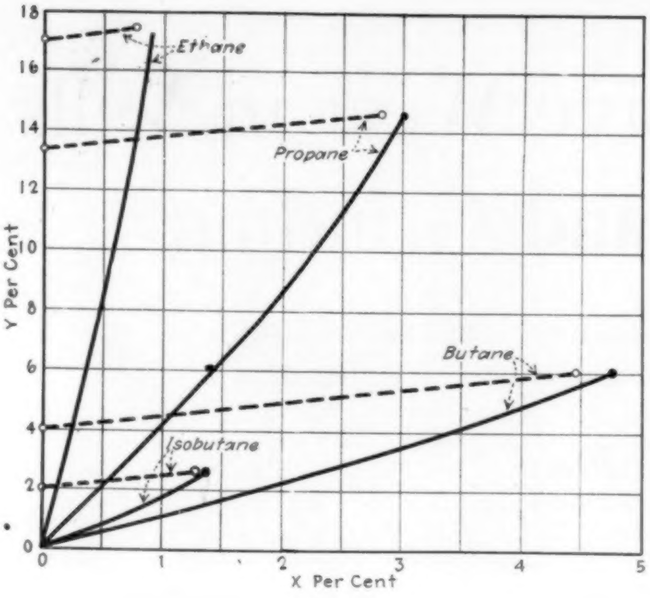


Fig. 2

the per cent saturation averages 94. The deviations from this mean value are largely due to experimental errors and give an idea as to the order of dependability of these particular data. The per cent saturation of pentane is only 59 and of the higher boiling constituents, assumed to average heptane, only eight. The last two columns, calculated from the preceding data, represent the analysis of the incoming and outgoing gas, expressed as a per cent of the inert gas in the mixture. Figs. 2 and 3 represent these data plotted as in Fig. 1. The per cent saturation for all low boiling components has been assumed constant at 94.

This method of approach makes it possible to design absorption units for natural gasoline on a rational basis, strictly comparable with the methods used in the less complicated cases with which the chemical engineer is more familiar. In general, one will design for the recovery of the most volatile component which it is desired to recover in quantity. It will then be necessary to make sure that the recovery of those higher boiling components next in order of volatility is satisfactory, but once this is done there need be no question about the recovery of any components of still lower volatility. Furthermore, the amount of absorption of the undesirable, more volatile constituents can be estimated with precision. This makes it possible to design, not only an absorption unit, but also the supplementary stripping equipment with a precision and dependability hitherto seldom realized. These methods are also directly applicable to stripping operations, it being kept in mind that the operating lines must be on the opposite side of the equilibrium curves.

Presented at the meeting of the American Institute of Chemical Engineers, Dec. 5-8, in St. Louis.

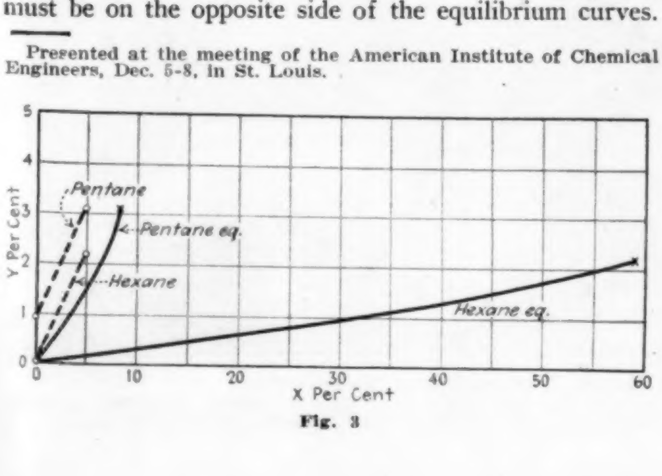


Fig. 3

Alcohol-Gasoline Blend Shows Advantages in Road Tests

ABSOLUTE ALCOHOL as a constituent of motor fuel has been demonstrated to possess anti-knock properties and to reduce carbon deposit by tests conducted under normal driving conditions. The results of these road tests are reported by William C. Moore, who supervised them.

A number of years ago the U. S. Industrial Alcohol Company began an extensive investigation into the merits of industrial alcohol as a constituent of motor fuel. After a period of preliminary investigation, it was found that anhydrous alcohol, mixed with ordinary gasoline, in any one of several proportions, constituted a motor fuel with many valuable properties. Chief among these were ease of acceleration on hills; smoothness of general performance, and the possibility of long continued periods of operation without the necessity of grinding valves or of removing carbon from the combustion space of the cylinders.

In carrying out this work the company adopted the policy of having those of its technical staff who owned automobiles put these cars through a series of tests to study the behavior of alcohol as a motor fuel constituent under varying conditions. The cars used included those of Ford, Chevrolet, Jordan, Buick, Willys Knight, Marmon, and Stutz manufacture.

Before beginning the tests, each motor was put in good shape and then was run for about 1,000 miles by the owner-driver on each of several fuels—a regular gasoline, a gasoline-benzol blend regularly sold in Baltimore, and the special alcohol gasoline mixture being studied. While this series of tests was under way, some of the cars were put over the same route three times in the same day on approximately the same schedule. On each trip one of the fuels above noted was used, and the amount consumed in each instance was determined accurately by weighing. This procedure gave a direct comparison under almost identical weather conditions, between the different fuels for the same car. After each test period, the engine was examined; the amount and character of carbon deposit noted. The average mileage per gallon was compared for each fuel. There was very little difference in mileage obtained with regular gasoline and gasoline-alcohol mixture. The difference in amount and type of carbon deposits in the cylinders, however, was quite pronounced, the carbon from gasoline being harder, more abundant and more difficult to remove than that from the alcohol mixture. Another advantage of the alcohol mixture was claimed by the drivers in better acceleration on hills.

The results of the tests are summarized as follows:

Alcohol, added to gasoline in proportions 20 to 30 per cent by volume, produced a fuel which gives smooth operating conditions, easy pick up, smooth acceleration on hills and freedom from fuel knocks.

One of the test cars, a Chevrolet sedan, was operated on this fuel for over 23,000 miles during one period and for about 20,000 miles during another period without having to have carbon removed from the motor.

A fuel containing 20 per cent alcohol compares favorably with commercial fuel containing lead tetraethyl as an anti-detonating fuel. When diluted to an alcohol content of about 5 per cent the knock eliminating properties of an alcohol fuel are still pronounced.

Preventing Excessive Wear in Mills For Crushing and Grinding

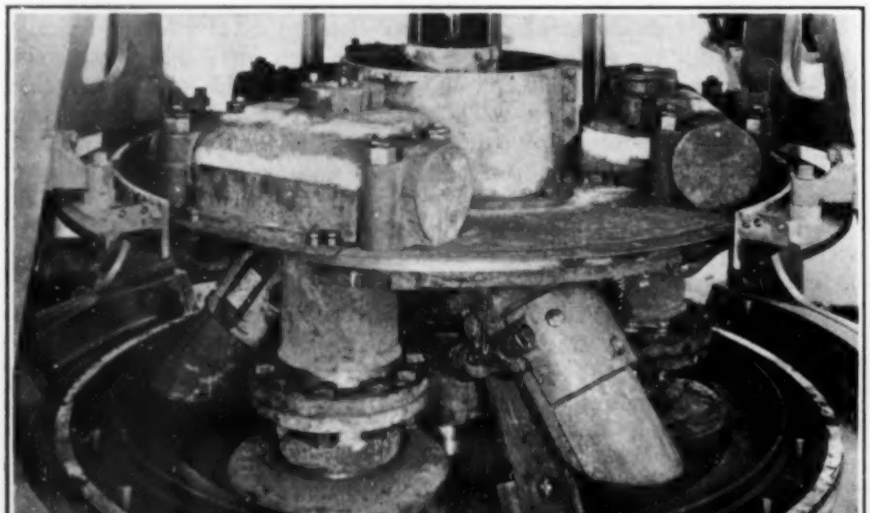
Welding a layer of Haynes Stellite to wearing surfaces results in many economies in cement manufacture

By B. E. Field

Union Carbide and Carbon Research Laboratories, Inc. Long Island City, N. Y.

NO OTHER industry faces such an acute problem in preventing the wear of its operating machinery and in the maintenance of production in spite of this wear as does the cement industry. The crushing and pulverizing of the limestone and cement rock, which comprise the principal raw materials going into the manufacture of cement, would ordinarily be considered very abrasive operations, but they are scarcely to be compared with the pulverizing and handling of the burnt clinker and finished cement. The fine particles of the finished product, 78 per cent of which must pass through a 200-mesh sieve, act almost like a sand blast on any material with which they come in contact. With the materials hitherto available the best the cement operator could do was to let the wear go and maintain a large stock of spare parts with the necessary help to substitute new parts for those that wore out. In view of this, shut-downs were frequent and often prolonged, with a consequent detrimental effect upon production.

The introduction of Haynes Stellite to prevent this abrasion has been of great importance to the cement industry. Its application, by welding it to the portions of machinery most subject to wear, greatly extends their life, reduces the number of shut-downs, lowers plant maintenance and makes reclamation of worn parts profitable. Haynes Stellite is a cobalt-chromium-tungsten alloy, and is the invention of the late Elwood Haynes. Until recently it has been much better known as a high-speed cutting-tool alloy used extensively for the turning of shells during the war and more recently in the automotive industry for the machining of automobile parts. This alloy is hard at ordinary temperatures and it has the unusual property of retaining its hardness almost unimpaired up to a bright red heat, which accounts for its value as a cutting tool. In addition, it is extremely resistant to wear or abrasion of all kinds and this explains its great usefulness in the cement industry. Haynes Stellite is supplied in the form of welding rod from $\frac{3}{16}$ in. to $\frac{3}{8}$ in. in diameter and it may be readily welded to steel or other metals by either the oxy-acetylene or the electric arc method. The welding operation by which the surface of a piece of steel or cast iron is coated with Stellite has been termed "Stelliting." Although it is a comparatively expensive alloy, the application of a thin layer by welding makes it possible to obtain its wear- and heat-resisting properties with an economical quantity.



Figs. 1 and 2—Bethlehem Three-Roll Mill Largely Used in Cement Manufacture

When used for grinding burnt clinker there is often a rapid wearing away of the grinding face of the ring against which the rolls work. This rapid wear may be largely prevented by welding a thin layer of wear-resisting alloy inside this ring.

Fig. 3—A Link of a Drag Chain Handling Cement Clinker

By welding a small bead of Stellite to the points of most wear, the life of the links and, therefore, of the conveyor system, is greatly increased.

Perhaps the best picture of the value of this development to the cement industry can be given by sketching roughly the progress of the raw materials from the quarry through to the finished cement. At the quarry the cement rock is broken up by blasting and is loaded into cars by means of a steam shovel, the teeth of which are rapidly worn away by contact with the broken rock. By Stelliting the ends and faces of these teeth their life is greatly increased. Varying conditions of operation make it difficult to gage this increase but it is much more than enough to justify the cost.

Several types of crushers, such as the roll crusher, gyratory crusher, jaw crusher, and hammer mill are used for crushing the rock as it comes from the quarry. The Fairmount roll crusher, which is widely used, has four rows of wearing blocks on the roll, each row containing five blocks. The manganese steel blocks are replaceable but they wear down under the excessive grinding action and also become wedged in the plate. This wedging and the battering of the bolt heads make the labor of removing a plate from the mill, replacing the worn blocks with new ones, and returning the plate to the mill, very considerable. This is an ideal application for Stellite, and by means of a layer $\frac{1}{2}$ to $\frac{3}{4}$ in. thick built up on the top and front face of the blocks the life is prolonged to from three to five times that obtained from un-Stellited blocks. In this case the major saving is in the economy of time for replacements, but the original blocks are also salvaged and may be rebuilt with Stellite when the original layer of Stellite eventually wears away.

There are two processes in use for the manufacture of portland cement, the dry and the wet process. They differ only in the methods of preparing the raw material, and from the point where the material enters the kiln they are identical. In the dry process the rock coming from the crushers passes through a drier, after which it goes to the grinder or pulverizer. The pulverizing is usually done in some modification of a Griffin or Hercules roll mill or in a tube-mill. In the roll mill the grinding is between the inside surface of a large steel ring and the face of a smaller steel roll turning inside of the ring. The mills are made with either one or three rolls but the three-roll type is the more common. For this type the grinding ring is about 66 in. in diameter and the rolls about 20 in. In a single-roll mill the grinding ring is only about 30 in. in diameter. The width of the faces of the grinding ring and rolls is approximately 9 in. The wear resulting from the grinding of the raw rock is not usually rapid enough to warrant Stelliting the grinding ring, but when the mill is used for grinding the burned cement clinker a Stellited ring is a decided advantage, as will be explained later.

The finely ground material coming from the roll or tube-mill passes to the kiln from which it emerges as red-hot cement clinker. This goes next to a cooler where it gives up much of its heat. If the kiln is set above the cooler, the clinker falls on to catch plates, the surfaces of which are Stellited, and then slides into the cooler by gravity. If the kiln is too low for this, the clinker is discharged into a pit and carried to the cooler by some type of conveyor. A drag chain conveyor is ordinarily used for moving the clinker along on the level. This is a continuous chain of rather large links running in a concrete trough and each link carries along a certain amount of clinker. The links are thus subjected to intense heat as well as to very severe abrasion. A bead of Stellite applied as shown in Fig. 3 lengthens the life of the links many times. Rider blocks are placed at frequent intervals along the bottom of the trough to support the drag chain and to prevent the trough from wearing away rapidly. Some of the blocks are steel with cast Stellite inserts and some are water cooled with the surface Stellited at the point of maximum wear. Drag chain conveyors are usually so situated that the idler and drive shafts receive a constant shower of cement dust and it is almost impossible to keep them lubricated. Sections of the shafts are usually Stellited and in many cases Stellite bushings are used in the bearings. A bucket conveyor is

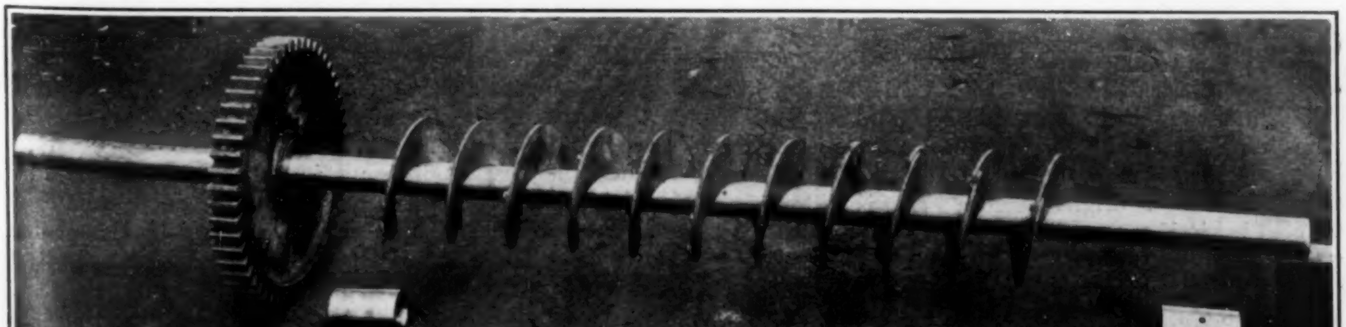


Fig. 4—Screw Feeder for Carrying Cement Clinker to a Tube Mill

The edge of the screw wears away most rapidly yet by applying a protective layer of Stellite to the inside and edge of the screw, its life becomes about six times that of plain steel. Stellite bearings are also shown in this view.

Fig. 5—Grinding Roll for a Single Roll Bradley Mill

In this mill the plows are mounted on the roll while in the three-roll mill (See Fig. 1) the plows are separate. The Stellite lining of these plows is apparent from the picture.

used to pick up the clinker delivered by the drag chain and raise it to the mouth of the cooler. Dumping cams and other parts of the bucket conveyor are Stellited where the wear is rapid.

From the cooler the cement clinker, mixed with a certain proportion of gypsum, passes again to a roll or tube mill for pulverization. These are the same types of mills that were used for pulverizing the raw stone. In the case of the roll mill the clinker is fed in front of each roll by a chute and is kept stirred by a plow just preceding the roll as the machine revolves. The nose of the plow is Stellited and in some cases the face of the roll also, but by far the most important Stellite application in this mill is the inside face of the grinding ring. When grinding is started and the faces of both the ring and the rolls are straight, the volume of material which may be handled is very large, averaging approximately 150 barrels per hour. When the inside face of the ring is not Stellited, it begins to wear away as soon as grinding is started with the result that production falls off, and at the end of the life of a steel ring, which is from 225 to 400 hours, the production of the mill may have dropped to as low as 90 bbl. per hour. Such a decrease in production is very serious. Stelliting the rings has not only greatly increased their life but has done away with this drop in production, for the Stellited face remains straight and the mill continues to grind at practically full capacity throughout the life of the ring.

ONE large cement company in the Bethlehem district has been conducting a very careful test on two mills of this type working side by side on the same material. A Stellited ring has been used in one mill and plain steel rings have been used in the other. Eight steel rings have been completely worn out and the ninth ring is now running, while the original Stellited ring is still in service without having been touched in any way. The life of this ring so far has been approximately 2,100 hours and the mill has averaged throughout this period a production of 145 to 150 bbl. of pulverized material per hour.

As the steel rings cost $210 each, their cost in the one mill has been $1,890 whereas the Stellited ring cost $1,150. It is apparent from these figures that the Stellited ring has not only paid for itself but has earned a profit of over $700 on first cost alone, not taking into consideration the labor cost of replacing the eight rings or the loss in production during the eight shut-downs; in addition the mill using the Stellited ring has ground at full capacity throughout the test whereas the mill using the steel rings has gone through eight cycles of decreasing production. When this Stellited ring does wear out, it may be reclaimed at a comparatively small cost by building up the worn spots with more Stellite. Another Stellite application in this type of mill is on the faces of thrust washers in the arms which support the rolls. This application prevents many shut-downs.

If a tube-mill is used for the pulverizing, a constant flow of clinker to the mill is maintained by means of a short screw conveyor. The edge of the screw wears away rapidly and the efficiency of the conveyor falls off in proportion. Wear also occurs on the shaft at the discharge end of the screw. Stelliting the shaft and the edge of the screw prolongs the life to an average of at least six times that obtained with plain steel. This is another application where Stelliting is important from the standpoint of maintaining production as well as in merely reducing wear. It is shown in Fig. 4.

The pulverized clinker discharged from the roll or tube mill is cement in its finished form but it must be transported to storage or to the bag house. It has been ground so fine that it will flow more or less like water and advantage is taken of this in moving it, although occasionally the moving is done by conveyors. In many cases it is pumped to storage by means of the Fuller-Kinyon pump. This very ingenious device consists of a short screw conveyor which feeds the cement up to an air nozzle or air ring, as it is usually called. The current of compressed air issuing from the many small holes around this ring picks up the cement and carries it through the pipe line to the storage bin or bag house. Needless to say, the parts of the Fuller-Kinyon pump wear very rapidly, and the faces of the flights nearest the air ring, the edges of all the flights, the face of the air ring itself and a section of the shaft from 12 in. to 18 in. beyond the air ring are all Stellited.

In the wet process for making cement the pulverizing is more likely to be done in a Compeb mill than in a roll mill. A Compeb mill resembles a tube-mill except that it is divided into two compartments and the grinding is done wet. The crushed rock is fed into the first section of the mill by a screw conveyor where large heavy balls reduce it to a certain fineness. This portion of the mill is short and at its end is a screen through which the material passes when it is fine enough. The second section of the mill is longer and has smaller balls than the first section. The material emerges from this mill in the form of a slurry and is pumped to mixing tanks from which it eventually passes to the kiln.

IT IS apparent that the advantages to be derived from the use of Haynes Stellite in the prevention of wear are by no means restricted to the cement industry. Many other chemical engineering industries use similar machinery, and while the service may not be as severe they can well profit by the use of the process. Hammer mills are widely used for the pulverizing of coke and other materials. The Stelliting process will greatly reduce the wear on the corners of the hammers. The pug mill is a common type in the chemical industry, and where the material being mixed is abrasive it is advantageous to Stellite the edges and sometimes the faces of the mixing blades.

How Do Patents Affect My Business?

A Manufacturer "Corners" a Patent Attorney and Evolves This Catechism Which is of Interest Even to Those "Not Particularly Interested in Patents"

By Roswell F. Hatch
Hartford-Empire Company, Hartford, Conn.

I am not particularly interested in patents. I use a few patented machines and make one patented article in a small way. The government stands back of my patent, so what information do I need?

IN THE FIRST place, the government does not "stand back of" or guarantee any patent. The only thing you get in a patent that you did not have before is the right to stop others from making, using, or selling the invention covered by the claims of your patent, for a period of 17 years from the date of its issue, *if* the patent is valid.

But surely I get the right to use my own invention?

Not at all. There may be other patents covering your invention. In granting a patent, the Patent Office does not consider whether or not the patented article would infringe prior patents. It is sufficient if your invention adds something patentable to a previous patent.

Please explain more fully how I can be stopped from using my own invention.

THIS will be best understood by a concrete example, Suppose you have a patent on a chemical composition composed of the ingredients A, B and C, together with a small amount of an ingredient D which you have found to add greatly to the stability of the composition. Your patent on the composition A-B-C-D may be valid, but if you find that someone has already patented the composition A-B-C, the fact that you have improved the material by adding the ingredient D will not save you from infringement if the character of the composition is not substantially changed. The prior patent might or might not be brought out by the Patent Office during the pendency of your application, but this makes no difference on the question of infringement.

In answer to my first question, you said, "if the patent is valid." Does the Patent Office grant invalid patents?

The Patent Office does not knowingly or intentionally grant invalid patents. Patents are granted only after a search and investigation made by the Patent Office for the very purpose of preventing the grant of invalid patents, and most of the patents granted are in fact valid patents.

Unfortunately, however, the Patent Office sometimes grants patents which are entirely invalid, or, more often, patents which contain one or more claims which are invalid, although, of course, this in not intentional, and it may be wholly the fault of the patentee.

This seems very unjust. How does it occur?

IT WOULD be impossible for the examiners in the Patent Office, even under the most favorable circumstances, to be familiar with all of the prior art in every line of invention. Before granting a patent, the examiners are supposed to search all prior patents in the class to which the invention is assigned and to use their general knowledge of the art to which the invention relates, but there is always the chance that the invention will be shown in some patent, perhaps in an entirely unrelated art, which the examiner will not find, and it might happen that the exact thing you have invented has been in use for years in some place not known to the examiner and of which no printed description has ever been published. You may think this is due to incompetence on the part of the examiners, but this is not necessarily so. The Patent Office cannot compete with private corporations in the matter of salaries, so that many of the best men leave to accept private positions. This condition has improved somewhat in the past few years, but there is room for further improvement. Again, there is no provision for training the examiners in the art they are searching. For instance, an examiner may be granting patents on mining machinery when he has never seen any such machinery or even a mine. The government does not provide for paying his expenses to see the practical operation of his art nor will it allow applicants or corporations to take the examiner on a trip of instruction. Many examiners pay their own expenses while on their vacations, for this purpose. Therefore, some little trick-of-the-trade, known to common laborers in some particular art, may be entirely new to the examiner, unless he happens to find it in some publication.

It should be remembered that the number of patents issued by the United States is now approaching two million and it is a very difficult task for any examiner to keep in mind even those patents relating to the art which he is examining. Nevertheless, invalid patents are the exception, not the rule. Of the large number of patents granted, the number declared invalid is small.

How can a patent be invalidated except through error of the Patent Office?

THERE are several laws relating to patent applications, the violation of any one of which might invali-

date the patent. Some of these are: The application must be filed before the invention has been on sale or in public use for more than two years; it must be made by the actual inventor (if living and sane) and no one else; the invention must not be abandoned at the time when a competitor files an application on the same invention; and in addition, there are numerous rules relating to the prosecution of the application which would ordinarily be taken care of by the attorney.

How can I find out whether my patent is valid?

The validity of a patent can be determined only by the courts. A good attorney, however, can give you an opinion on validity which will be good until the courts decide otherwise, at least.

But I don't know any attorneys. How can I select a competent man?

You probably do business with firms who have patent work regularly or perhaps patent departments of their own. They can advise you. Do not forget that the attorneys who advertise the most are not necessarily the best.

You say my patented product may be infringing some patent. How can I determine if this is so?

Consult a good attorney. He may be able to assure you that you are reasonably safe from infringement, or, if there happens to be a close question, he will give you his opinion. If the other party brings suit against you, you will have an opportunity to determine the accuracy of this opinion.

Can't my lawyer give me such patent advice as I need?

No, not unless he specializes in patent law. A member of the bar cannot practice before the Patent Office unless he is registered there as a patent attorney. He may be able to recommend a patent man to you.

I use some patented machines in my business, bought from the makers. Is there any chance that I can get into patent difficulty with these?

Yes, you can infringe a patent by making, using, or selling the patented article. Unauthorized use is just as much an infringement as making the device.

The maker of one of these machines advertises "guaranteed against infringement." This will protect me, will it not?

THIS expression implies that the maker will protect you from loss by any infringement suit, but it does not make this statement directly. There are several questions left unanswered: Will he defend you in case of suit? Will he pay the cost of your defense? Can you find him when you want to collect costs and damages if you lose, and your expenses if you win? Will he have any money to reimburse you with? This "gauarantee" does not mean much unless backed up by an agreement with a reliable firm; in fact it is practically nothing but trick advertising. If your alarm clock is guaranteed to run a year without repair, you can expect a new one, or at least free repairs if it fails, but if your patented machine is found to be an infringement, the maker cannot replace it with another just like it. No one knows just what he will or can do.

Apparently I am running the risk of an infringement suit every time I buy anything. Is there no way to avoid this?

IT IS true that you may be infringing by the use of many processes or tools. However, the owner of a patent is not likely to sue you as the user of one or two machines, if he can stop the source of supply. The damages he might collect from one small user would not warrant bringing a suit, when he could bring suit against the maker of all of the infringing articles. Your safeguard is to buy from reliable dealers, and, if you are making a big investment, have the patent situation investigated by your attorney.

Is it not possible for me to read my patent and to determine for myself what it covers?

Yes, this is possible, but as a general rule, it is not a safe procedure. The scope of your patent is determined by the claim or claims. The drawings (if any) and description must comply with certain rules, but neither of these can add anything to the claims. Your drawings and description may disclose a whole oil refinery but your claims may cover only a pop valve on a certain pressure tank. Once more consult an attorney if you want to know just what your patent attempts to protect. Claim language is generally too technical for interpretation by a layman.

I have been told that anyone is at liberty to make a patented article or to practice a patented process, for experimental use only. Is this correct?

NO, THERE is no provision in the patent law to exempt anyone from infringement if he follows the teaching of a method patent, or makes or uses a patented article for any purpose whatever.

Of course, it is not at all probable that anyone will sue you for making a single experiment for your own information and from which you receive no profit. It is often said that one can make or use a patented invention for his own personal use, but this is a technical infringement.

Is it necessary for me to mark my product "Patented"?

It is not necessary, but it is highly desirable. If you do not mark your product, you cannot collect damages from an infringer until after you have notified him of the existence of your patent. If your product is marked, the infringer is assumed to have notice of your patent and you can collect damages from the time of his first infringing act.

How should it be marked?

If you are manufacturing under a patent granted since April 1, 1927, you must mark the product or the container "Patent No." followed by the number of your

patent. If your patent was granted before that date it is sufficient to mark your product "Patented," followed by the date of the patent. It is preferable to use the patent number in both cases.

If I file an application for a patent, should I mark the article "Patent Applied For" or "Patent Pending"?

It is probably advisable to do so, but there is no provision in the patent law for such marking. The only possible use of such marking is that it will scare off a competitor from copying your product because he fears the expected patent. There is no certainty that such patent will ever be granted. You can file an application on almost anything if you want to, so this mark really means nothing except that the maker hopes to obtain a patent. Be careful, however not to mark an article "Patented" unless it really is covered by a patent in which you have an interest.

Am I protected and at liberty to market my product as soon as my application is filed?

If you intend to patent an invention, the application should be filed promptly, but this does not protect you if you mean to ask if it gives you any rights against one who copies it. You have no rights against an infringer until your patent is granted; in fact, there can be no infringement. You can use and sell your invention for two years before forfeiting your right to file a patent application but if the invention is worth an application, file it as soon as possible. Delay in filing may permit a competitor to take the patent from you if he happens to file his application first.

Can I get my patent renewed or extended?

No. The law provides for such extension by act of Congress, but there is no likelihood that it will ever be done.

Some articles carry a long list of patent dates, indicating that the patent protection has been extended from time to time. What do these mean?

The successive dates indicate that different patents have been granted from time to time, but each patent must be on a different feature of the machine. For instance, several patents appearing on a phonograph might apply, one on the horn, one on the motor, one on the reproducer, and so on. Each patent must differ from the other, although one patented feature might enter the combination of another patent. In the phonograph, you might have one patent on the previously patented horn mounted in the cabinet in a novel way.

If a man working for me gets a patent on my product, does this patent belong to me?

THIS question cannot be given any general answer. If the man were employed specifically for the purpose of inventing improvements in your product, the invention would in all probability be your exclusive property. In most cases, you would at least be entitled to use the invention, but you might not be able to stop the man from giving your competitors the same right. In order to save trouble, have all employees who are in such a position that they might make inventions on your product, sign a contract stating that such inventions and patents thereon are to go to you without further consideration.

What is the value of a patent, anyway?

PATENTS generally are respected, not defied. Few manufacturing concerns will deliberately embark on the infringement of a patent owned by a competitor or by some independent inventor without first making an investigation of the patent. If, as a result of the investigation, the patent appears to be a valid patent, the manufacturing concern will ordinarily respect it or endeavor to obtain rights under it. If the patent appears to be of questionable validity, the manufacturing concern may feel that it can afford to take the risk involved in its infringement, but even in such cases the fear of litigation is often a deterrent against infringement. We have no record of the number of patents which are respected, but the frequent purchase and sale of patents and of licenses under them, together with the development of new industries based upon patents, indicate that patents are quite generally respected and represent valuable property rights. Manufacturing concerns generally protect their own developments by patents, and, from a sound business standpoint, cannot well afford not to do so.

A patent on a worthless product is of no value to anyone except sometimes to aid in the sale of equally worthless stock. It has been said that a patent is simply a license to fight. In a sense, this is true; it is a license to go into court and to enforce your supposed rights. But if you do not have the patent, you certainly have no right to restrain those who copy your invention.

Only a small percentage of the patents granted ever reach the stage of litigation, and of those litigated about as many are held valid as are held invalid. For the most part it is the patent of doubtful validity which becomes involved in litigation. Patents which are clearly valid are less likely to become involved in litigation, although there is often an honest difference of opinion both on the question of validity and as to whether or not the alleged infringing device actually is an infringement.

If I have a patent, can I get an injunction to restrain an infringer, without bringing suit against him?

As a general statement, no, unless your patent has been adjudicated in a previous suit, and very likely, not even then. Even if the patent were sure to be valid, the question of infringement is usually too uncertain to warrant a preliminary injunction. Infringers seldom make a Chinese copy of the patented device. It is quite different from a clearly worded contract, agreed to between the two parties, and setting out just what each one may or may not do.

These questions must indicate to you that I am very stupid and incompetent to manage a highly competitive business.

Not at all, they are exactly the questions that most people in your position ask when they are first faced with any patent difficulties. If more manufacturers would ask similar questions before they get into trouble, there would be less patent litigation.

Electrical Heating Field Broadened by Container-Resistance

By R. A. Carleton
Carleton-Mace Company, Boston

ELECTRICAL HEATING for process use has been the subject of a great deal of discussion in the technical literature of recent years. It has generally been realized that while heat obtained by electrical means is usually more costly than that obtained in other ways, nevertheless it is frequently true that the superior product which may result from the use of electrical heat, or the labor savings thus made possible will actually bring about a reduction in over-all costs. In other cases the necessity for very close control, the requirement for high process temperatures, or of quick heating and cooling, or the existence of a fire hazard may swing the balance in favor of electrical heat in spite of lower over-all costs for competing means.

It is also true that there are many instances where electricity may be a by-product of the generation of process steam and may be used at by-product cost to replace oil heating or other high temperature methods in certain phases of the process where elevated temperatures are requisite. Of course, it is obvious that not all industries can yet afford the luxury of electrical heat at the present state of the art, but where there is any possibility of its successful and economical application, the manufacturer will do well to give it his serious consideration. The advantages of electrical heat in general are so many and so evident that nothing further need be said about them here.

Electrical resistance heating may be said to be of three types, depending upon what constitutes the resistor. In the first type the material undergoing processing serves as the resisting element. This is somewhat comparable to processes where part of the product is burned to supply heat for the rest, and is exemplified in the manufacture of silicon carbide. The second type is that of indirect electrical heating where energy is made to heat elements which are in contact with the processing container or otherwise separated from the material being treated. Heretofore, all successful resistance methods in which the first type was not used have been of this nature. The analogy here is that of the steam or oil heated kettle, still or reactor. The third type is aptly described as intermediate between the first two in that the container, or some integral part of the container serves as the resistor. Our best analogy here is that of the direct-fired muffle or caustic pot.

THE FIRST METHOD, unlike its prototype, is probably ideal in the few instances where it can be used. The second has wide application, but presents the disadvantages that uniform temperature distribution is almost impossible of attainment, that hot spots are difficult to prevent, that heating elements are likely to burn out, that the elements are limited in their current-carrying capacity, that rapid temperature variations cannot be obtained and that closest control is not possible because of the lag inherent in the method. Such equipment is also, of necessity, quite costly.

Many attempts have been made to adapt the third method to industrial use. It has been only recently, however, that these attempts have met with any great success. The difficulty of self inductance in the apparatus, resulting in a very unfavorable power factor, coupled with the mistaken impression that fairly high voltages were desirable, has retarded the early acceptance of this means. It is only through comparatively recent investigations that low voltage apparatus in which high power factors are attainable through the virtual elimination of self-inductance, have been developed and in some instances, placed in the chemical engineering industries.

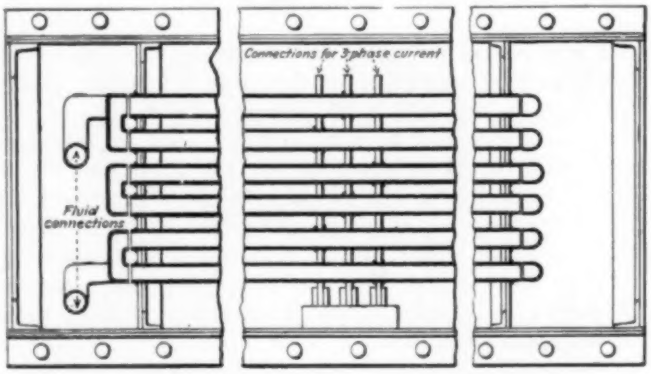


Fig. 1—Tubular electrical heater for varnish processing
The heater shown above is intended for use with 3-phase current. Each of the leads at the center connects to four tubes through which the gum-oil mixture is passed. By this arrangement self inductance is reduced to a minimum assuring a high power factor. The varnish may be processed in a closed system, reducing labor, hazards, time and contamination.

The possible applications of this principle of heating are many and varied and apparently limited only to the ingenuity of the designer. Some of the types of equipment which have been adapted to this use at present are rolls for paper and textile machinery, kettles, vapor-phase oil cracking stills, high temperature and pressure heaters for oil, steam or vapor generators, evaporators, instantaneous heaters for liquids, and varnish compounding systems.

In some classes of apparatus the container itself is best made the resisting element. In others the resistor may consist of plates or tubes inside the container or shell. These are made part of a low voltage electric circuit. In some instances, the container may form a part of the circuit but may not be required as a portion of the heating element. In any case, the heating element is of com-

paratively high resistance, and where this does not include the shell, the latter is constructed of material having the lowest practicably obtained resistance, consistent with the other physical or chemically resistant properties required.

Low self-inductance is made possible through the expedient of doubling back the circuit on itself as frequently as possible. By this means the current flows at every instant in opposite directions in adjacent parts of the circuit. Where the container forms the resistor it is made double-walled, with the heating surface proper of high resistance, and the false shell, electrically connected at one end, of low. When tubes form the heating element, the shell may be made the low resistance side, serving to neutralize self-inductance, or the tubes may be so arranged and electrically connected that current flow is opposite in adjacent tubes. If plates are used for the resistance, alternate plates form opposite sides of the circuit.

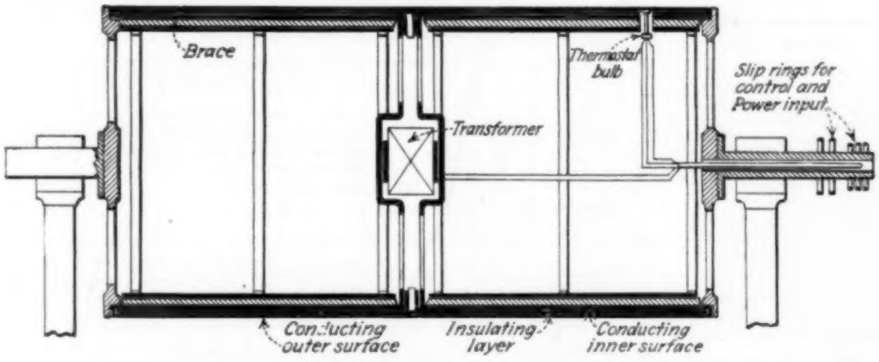


Fig. 2—Electrically Heated Paper Machine Drier Roll

The roll is double with the inner cylindrical portion in two parts which serve as leads and reduce self inductance. Power is taken from slip rings through a transformer mounted within the roll, preventing noticeable losses of current in the ineffective part of the low-voltage secondary circuit

THE PRINCIPLE is susceptible of use in connection with sources of any available current, direct or alternating, single or polyphase. Direct current sources must obviously supply a suitable low potential of a few volts. Alternating current may, however, be taken at any primary voltage and, through the use of a step-down transformer, reduced to an e.m.f. of suitable magnitude. Temperature control means may be used in which a temperature-actuated element is made, by means of an auxiliary control circuit, to regulate the primary voltage drop, and hence to adjust the secondary current which flows through the heating element portion. This obviously controls the temperature of the apparatus. While the secondary current is necessarily large, losses in the inactive parts of the circuit are made relatively unimportant by the use of low resistance materials and current paths as short as possible.

The fact that several of the best materials from the standpoint of resistance to corrosion, for example Monel or high chrome steels, are also of relatively high electrical resistance, is fortunate. They are obtainable in various forms of very uniform thickness, making possible the fabrication of equipment for many process uses. In such equipment, uniform temperatures are obtainable throughout the heating element without the danger of hot spots and element burn-outs. A very low temperature gradient may be carried between the heat source and the material processed, which is an obvious advantage where delicate control is necessary. The use of parts of the equipment which are actually in contact with the liquids as the resistance elements makes it possible to change temperatures rapidly. The apparatus may be heated from the cold, or cooled to room temperature quickly and easily. The heating capacity of such equipment is limited only by the heat absorbing capacity of the material processed and by the characteristics of the transformer and line. For this reason, smaller equipment is possible than must be used with other methods and greater production is obtainable in a given space. All of the heat produced in the element, neglecting the small radiation losses, goes to heat the processed material, making high current utilization efficiencies possible. A number of applications of container-resistor heating methods are illustrated in the accompanying pages. Fig. 1 shows a fully enclosed varnish heater for use in a continuous varnish-making process. Since there is no possibility of fume loss, there is no fire hazard and no loss of valuable ingredients by evaporation. The use of a heat exchanger in connection with the heater conserves energy and enables coolers to be eliminated. The oil and resin are first quickly brought to the desired temperature in the exchanger and heater and are then held as long as desired in a reaction chamber at whatever temperature is necessary for heat-bodying. The latter apparatus may also be electrically heated to take care of radiation losses. The varnish-making process may thus be carried out with less labor and loss than by the old methods, with less contamination of product, and at a much higher reaction rate.

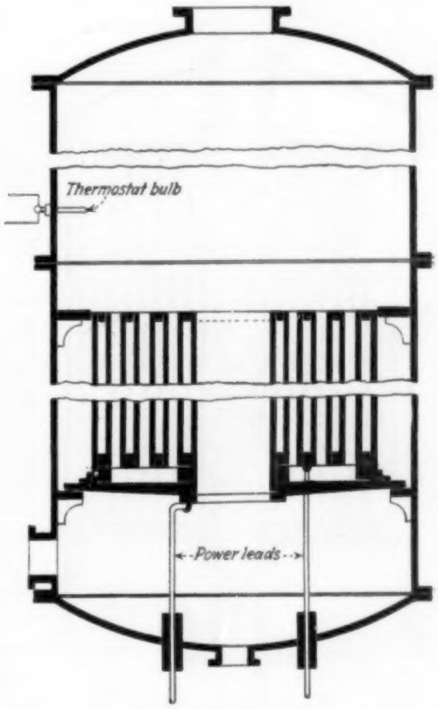


Fig. 3—High Temperature Electrically Heated Evaporator

The tubes, both sides of which are presented to the liquor in the evaporator, form one side of the circuit while cylinders bounding the tubes inside and out form the return. With all the resistance effective, large capacities are possible.

A PRACTICAL adaptation of the system to a paper machine dryer roll is illustrated in Fig. 2. The outer surface of the roll forms the resistor while the circuit is completed to a transformer mounted inside the roll by means of two low resistance cylindrical sections joined to the outer shell at the ends, but insulated from it elsewhere. The average roll temperature is measured and controlled by a thermal element of the gas or oil-filled variety encircling the heating surface and in close contact with it.

Fig. 3 shows the principle applied to a high temperature evaporator in which the tubes form a part of the circuit while the self-inductance neutralizing return is provided in the form of inner and outer cylinders bounding the space occupied by the tubes. Since both inside and outer surfaces of the tubes are in contact with the evaporator contents, rapid circulation and large capacities are possible in relatively small equipment.

In Fig. 4 this method of heating has been applied to

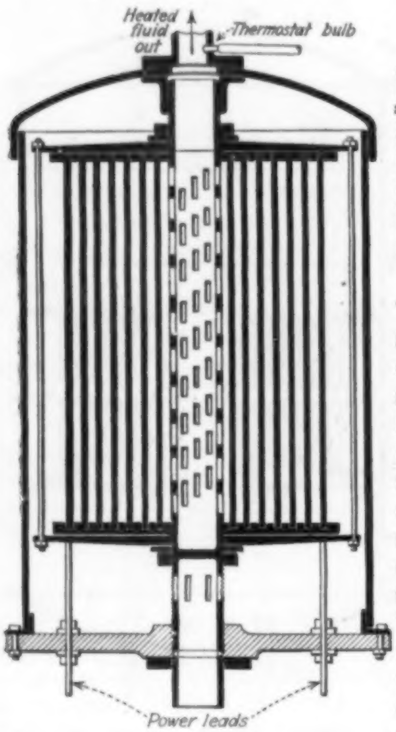


Fig. 4—Instantaneous Electric Liquid Heater

The heating elements consist of two concentric spirals of resistance material connected at the center to the discharge tube. Current flows in through one spiral and out the other. Liquid passes in at the bottom, between the spirals and out the center tube. With cold liquid at the shell, no lagging is required.

still another class of equipment, in this case, an instantaneous liquid heater. While the section shown does not make it entirely evident, the heating elements consist of two concentric spirals of resisting plate material. The spirals make contact only at the center where they are electrically joined to the central discharge tube. Current flow is in through one spiral and out through the other. Cold liquid flows in at the bottom of the heater and surrounds the spirals, then flows between them, and is heated as it flows, thence out the discharge tube at the center. Since the cold liquid is always in contact with the outer shell the apparatus is self insulated and requires no lagging as it has no radiation losses.

Only a few of the possible applications of container-resistance heating have been illustrated. Another which has proved to be peculiarly suited to the needs of chemical industry is an electrically heated kettle. This is made by providing an outer shell which contacts with the container proper in some plane across the kettle below the probable liquor level. Rapid heating is thus assured, together with a high power factor. Where rapid cooling is also necessary the shell may serve as a jacket for cooling water or brine, with provision to facilitate the removal of the cooling medium when heating is to be resumed.

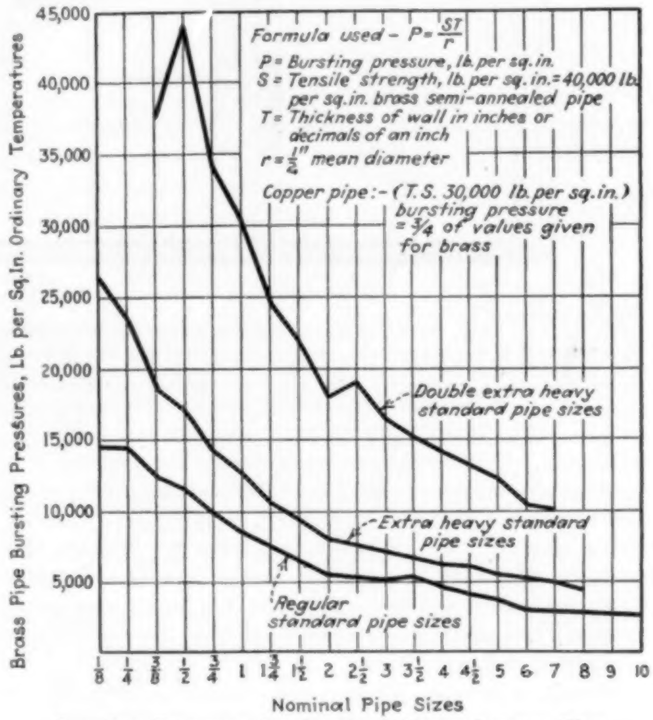
Throughout the foregoing description it has been tacitly assumed that the reader will appreciate the possibilities for attainment of temperatures even higher than may be reached using oil heated apparatus. This feature together with the others which have been emphasized indicates an ever increasing field for the container-resistance method of electrical heat generation in the chemical engineering industries.

By way of acknowledgment, the author wishes to thank the National Electric Heating Company of Boston who control the patents on this type of heating, for much of the material which served as the basis of the foregoing discussion.

Bursting Pressures of Brass and Copper Pipe

By Wm. G. Schneider
Copper and Brass Research Association, New York

THE CHART reproduced below is calculated from a recognized equation known as Barlow's formula, and may be used with safety for obtaining approximately correct bursting pressures of tubes.



Bursting Pressures for Standard Sizes of Brass Pipe

The formula may be used for practical conditions where the atmosphere is the external pressure or where the external pressure is moderately greater. In this case the difference between the inside and outside pressures represents the bursting pressure being exerted. It is assumed that gage pressures are referred to and also that the tube is longer than its diameter.

Barlow's formula makes use of half the outside diameter of the tube for the radius. Results obtained by using such figures, it is felt, err too much on the side of safety and, therefore, the chart has been calculated using as the radius one-half of the outside plus inside diameter divided by two, thus giving the mean diameter. A comparison between results obtained by using the two different radii shows an almost negligible difference in the larger pipe sizes. However, in the case of the smaller, the pressure obtained by use of the outside diameter may be 15 per cent below that using the mean.

The Future of Industrial Gas

With gas today, admittedly the most expensive source of heat on a B.t.u. basis, much discussion concerns its future in competition with other fuels. Although but two per cent of the country's heat is now supplied by gas, the potential market for the fuel is much greater. It is generally conceded that cheaper gas hinges upon better rate structures and a peakless demand. Proper utilization of off-peak gas and a "super-power" type of organization will be contributing factors.

Products and Profits of SOAP *Maker Extended by Technology*

By H. J. Morrison
Consulting Chemist, Procter and Gamble Company, Ivorydale, Ohio

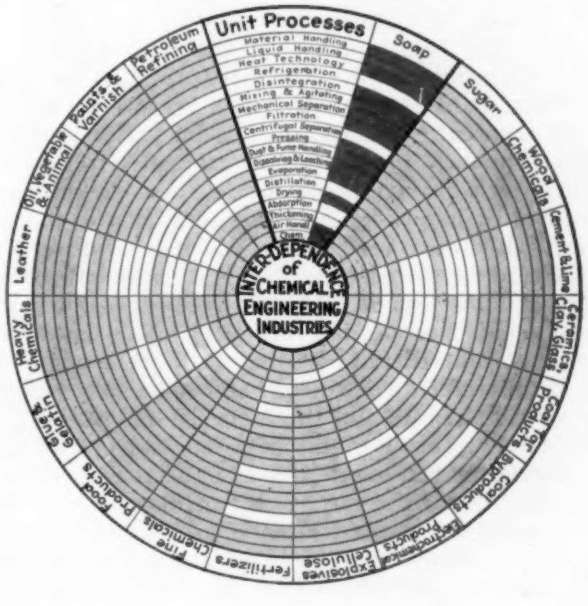
SOAP MAKING is one of the oldest of the chemical arts. It was, however, for many centuries a true art, in that it rested on no scientific knowledge but depended entirely on the skill of the artisan. Its first stride forward to a sound scientific foundation was due to a fundamental discovery in another chemical industrial field. The discovery of a method to make carbonate of soda from salt was based and worked out on scientific lines. The discovery of LeBlanc was a foundation stone in the heavy chemical industry and, thus, must be regarded in the same light in the soap industry.

Since soda ash or caustic soda are primary materials for the soap maker, all advances in the alkali industry are of the utmost importance and interest to the soap maker. The cost of this raw material has been steadily reduced, due to the chemical and engineering ingenuity and supervision and the utilization of by-or waste products. The conversion of hydrochloric acid, which was produced in immense quantities far beyond all needs in the old LeBlanc process, to hypochlorus acid as chloride of lime is an illustration. It was this same chloride of lime which made the LeBlanc process a competitor for many years of the newer ammonia process. With the fall in cost the quality has not suffered, but has improved, until today the purity of his soda is the least of the soap maker's worries.

Fats and oils, the other primary raw materials of the soap maker are not the product of a single industry, being drawn from all corners of the earth and across the seven seas. The chemical engineering processes used in the production of these fats and oils are likewise many and varied. The principal processes are the "trying out" methods of the meat industry and the fish and whale oil producers. The vegetable oils are mainly produced by expression, but solvent extraction is making great strides. These processes must, however, be modified to suit the particular material handled, and the chemical engineer has a very fertile field for his ingenuity, in some cases using a combination of processes. For example, the fish oils are produced by both cooking and pressing.

These two primary products, soda and fats, are common to all soap makers. Their need and dependence on other chemical engineering industries depend somewhat on the size of the establishment and the particular line or lines of soap making followed.

If the soap maker finds it necessary or advantageous to crush various kinds of oleaginous materials such as copra, cottonseed, etc., he is led into another field which



gives him many contacts with the chemical engineers of the vegetable oil industry, whose problems are discussed elsewhere in this series of articles.

THE LARGER manufacturers make their own caustic from soda ash and refine, bleach, or otherwise manipulate the oils and fats used. These activities lead them into many other fields demanding many of the machines, processes, and materials of other chemical engineering industries. For caustic soda making, lime is required, lime of high quality, well burned, and withal cheaply laid down; or apparatus for regenerating or recausticizing the spent lime may be used. For this latter operation are required thickeners, filters, rotary furnaces and heating devices. There are other methods of producing caustic from carbonate in use, such as the ferrite process which is used in several large plants. The electrolytic production of caustic soda is of considerable volume, but does not approach the volume produced by the other methods, the disposal of chlorine in this process being the limiting factor. As outlets for this element are found, more and more electrolytic soda will be produced, especially in those plants which can use the hydrogen simultaneously generated.

Among the larger soap makers it has been found economically necessary to take the entire output of certain oil and fat producers. Under these circumstances, much of the oil and fat received is of edible grade and commands a price from 20 to 25 per cent over its value as a soap making material. These concerns have, therefore, found it advantageous to enter the refining industry and produce edible oils and fats. In preparing an

oil or fat for edible purposes, the free fatty acids are first removed as soap by caustic soda treatment, the neutralized oils being thereafter bleached and deodorized.

The refining and processing of oils for edible purposes and the improving of the lower grades to make acceptable soaps has led the soap-maker to draw on the experience and products of other chemical engineering industries. Carbon and fuller's earth for bleaching have long been known, but it is only in the last yew years that great strides have been made in activating these materials, so that their bleaching values have been greatly increased.

DURING the last twenty years following the discoveries of Sabatier in catalysis, this method of reaction has been applied to the hydrogenation of oils. Oils in themselves make soft soaps, and the supply of natural hard fats has decreased because of the skill of the chemical engineers in those industries producing them. The meat industries now can save practically all of these for edible purposes. Under these circumstances, a method of hardening oils came as a boon to the soap maker. Likewise, certain oils which heretofore could not be used for the general run of soap have now become available to the soap maker. Thus, the oils of the marine animals contain certain fatty acids of a highly unsaturated nature, and the characteristic smell of these oils is due to this unsaturated constituent. By saturating this acid, the odor disappears and the hardened fat has, in fact, less odor than many of the best fats and is chemically not much different, except possibly a slight difference in the proportion of the various fatty acids one to another.

A hydrogenation plant requires a variety of chemical engineering knowledge. There are a number of catalysts used, usually nickel, the source of which is one of the nickel salts. The recovery of this catalyst when spent, due to poisons in the fat or in the gases, calls forth considerable apparatus and chemicals. The production of hydrogen for this process constitutes in itself a problem in chemical engineering.

The byproduct of the alkali refining operation, the soapy matter or "foots," is in part used for the making of low grade soaps and soap powders, but for the most part is reconverted into fatty acids and distilled, which process calls for such chemical engineering apparatus as stills, condensers, vacuum apparatus, etc. The fatty acids produced by this distillation are further processed by chilling and pressing to separate the solid crystals of stearic and palmitic acids from the liquid unsaturated acids.

THE MAIN byproduct of the soap industry is glycerin. The recovery of this product calls for the chemicals of a number of industries, principally those of the heavy chemical works. The impurities must be largely eliminated before evaporation is undertaken. Because the glycerin is received in a relatively weak solution, it requires the most up-to-date apparatus of the evaporation engineers for its economical recovery. The salt used in the soap making operation, which is in the spent lye solution, must be separated without entraining more than traces of the glycerin, requiring centrifugals or filters. After concentration and elimination of as much salt as practicable, the product must be distilled under vacuum with superheated steam. Finally, activated carbons are used for taking out the last traces of color.

The soap having been made, it must be manipulated for the various uses to which it is to be put. If for toilet purposes, it should have been made from the very best of fats. A very large proportion of the soaps used for toilet purposes are the white floating soaps which are beaten up with air. The apparatus for this purpose must turn out a soap of even texture and uniform specific gravity. Such a machine has been perfected by chemical engineers.

Other toilet soaps are made by what is called milling and plodding. The soap curd as it comes from the saponification kettles is partly chilled on rollers and partly dried by passing through chambers made by engineers skilled in the drying art. It is then worked many times over crushing rollers and the structure of the soap thoroughly broken up. It finally comes to the plodding machine in a putty-like condition and can be extruded through dies to form the blanks for the individual cakes. During the process of milling and plodding, such materials as perfumes, dyes, etc., are added.

On the other hand, if the soap is to be used for household cleansing or any of the other great variety of cleansing problems, it may have added to it certain builders, water softeners, and other detergent assistants. These call for the products of the sodium silicate producers, the phosphate industry, or if an abrasive soap is to be made, for one of the various pulverized mineral materials, such as ground pumice or feldspar and the like, these abrasives being selected to fit the various purposes for which the soap is to be used. If for scouring surfaces which might be injured by a material as abrasive as pumice, feldspar would be preferred. However, a great variety of abrasives are used.

STEAM laundries are taking large quantities of soaps and, through co-operative fellowships in scientific institutions and the laundry service of soap manufacturers, are standardizing their requirements. The laundries recognize the advantage of getting pure and guaranteed soaps, and particular soaps for particular purposes. Here again the chemical staffs of two industries must work hand in hand for mutual benefit. Haphazard methods have given way to standardized procedure, checked continuously for color of work, tensile strength of goods, etc., in standard tests pieces. The same applies in the case of the specific requirements of the textile industry.

Those soap makers who cater to the toilet trade almost exclusively find it to their advantage to put out lines of perfumes and other toilet accessories, such as lotions, talcum powders, shaving creams, pomades, etc. All of these require a great variety of the products of other chemical industries and chemical engineering devices. To the casual observer this might appear to be a very small outlet. The amount of alcohol used in the manufacture of these various products is in itself an exceedingly large item. The amount of money spent in a year in this country for toilet accessories is astounding—more than a quarter billion dollars.

The influence of the chemical engineer is not confined to the production departments of the soap industry. Many of the users of his glycerin require his co-operation in adapting it for use in pharmaceuticals, dynamite, anti-freeze, as a meter liquid, etc. His development of shipping cartons has practically "exterminated" the "soap box." Even the printed label on the bar of soap has drawn his attention, for the ink must not run when it becomes damp and permeated with soap. In short, the chemical engineer in the soap industry finds applications for his knowledge on every hand.

Chemical Engineer's Bookshelf

THE MAKING OF A CHEMICAL. A Guide to Works Practice. By *E. I. Lewis*, M. A. (Cantab.), B. Sc. (Lond.) and Geo. King, M. Sc. (Birm.) F.I.C. John Wiley & Sons, Inc., New York. 288 pp. Price $4.

Reviewed by CHAPLIN TYLER

THIS little book might be termed an introduction to industrial chemistry. It is an elementary book (not a handbook) and encompasses an amazing assortment of subject matter, essentially as follows: qualifications of the chemist; laboratory equipment; laboratory practice; the experimental plant; the works plant; production costs; selling costs; materials of construction; transmission and measurement of energy; types of unit operation equipment and operation thereof; furnaces; electrolysis; management; and glossary of miscellaneous equipment. Needless to say, hardly more than generalities can be disclosed with such an ambitious table of contents; for example, electrolysis is dismissed painlessly in a chapter of two and one-half pages.

For the most part the book is well written, although in places verbosity threatens. Thus, on page 39 (referring to laboratory buildings), we find this passage: "Attached to them in well-organized and well-found departments, is a special store of vessels and other apparatus, whose range in material, design, and dimensions astonishes and even intimidates the tyro. Such, at any rate, were the emotions produced by the array in the authors of this book."

On page 44, reference is made to *Chemical and Metallurgical Industry*, presumably meaning *this journal*. On page 162 it is inferred that "the oil fields of Pennsylvania" are an attraction to the manufacturer wanting "cheap steam."

Many undergraduate students will doubtless be repaid by reading this book; however, it is believed that the better schools of chemical technology provide in their regular courses at least the equivalent of such general insight into works practice.

* * * *

New A.S.T.M. Standards

A.S.T.M. Standards, 1927. Part I, Metals; Part II, Non-Metals. American Society for Testing Materials, Philadelphia. Part I, 878 pages; Part II, 1,006 pages. Price, Parts I and II, cloth, $14; half leather, $17.

The 1927 Book of Standards is published in two parts, Part I covering Metals and Part II covering Non-Metallic Materials. In these two parts appear the 340 standard specifications, method of test, definitions of terms and recommended practices in effect at the time of publication. The Book of Standards is issued triennially. Those standards which are adopted by the Society in the intervening years are published in supplements to the Book of Standards.

Part I contains standard specifications and methods of testing many of the materials used in the construction of chemical engineering equipment. Part II includes standard methods of analysis and specifications for a wide variety of products used and produced by chemical plants. Each subject is designated by a serial number which aids in locating desired information, as do the marginal subheads. The books are nicely printed and well bound.

A third volume of 824 pages covers tentative specifications, that is, proposed standards which are printed for one or more years with a view to eliciting criticism and suggestions before final adoption. This volume is priced at $7.00 bound in paper and $8.00 in cloth.

* * * *

Lubricating Greases

LUBRICATING GREASES. By *E. N. Klemgard*. The Chemical Catalog Company, Inc., New York. 198 pages. Price, $5.50.

Reviewed by GAVIN R. TAYLOR

This book gives much valuable data on the manufacture, testing and uses of lubricating greases. It describes in detail manufacturing methods for the important types of greases, such as those having a lime, soda, lead or aluminum soap base as well as many greases and lubricants for special purposes. In the past the processes used for the manufacture of these special greases have as a rule been considered as trade secrets and comparatively little of value can be found in the literature on the subject. Although the greater part of the book is devoted to grease manufacture the brief description of the methods for the utilization of greases is more reliable and up to date than in most of the books dealing with lubrication. A brief review of many patents on lubricants is also included and the last chapter deals with the trend of grease research. This book should be of great value to those interested in grease manufacture, research or in lubrication problems.

* * * *

Historical Romance of Explosives

HISTORY OF THE EXPLOSIVES INDUSTRY IN AMERICA. By *Arthur P. Van Gelder* and *Hugo Schlatter*. Columbia University Press, New York. 1,132 pages. Price, $10.

Reviewed by A. E. BUCHANAN, JR.

AN EVENING with this formidable looking volume is almost as pleasant as strolling back through the years and shaking hands with all the old friends in the explosives business. Familiar faces greet one as the pages turn, while the captions recall their accomplishments and their contributions to the industry in such a way as to bring home suddenly the realization that they have been making history, these friends of ours—the romantic history of explosives. Just as effectively as it makes historical characters of our contemporaries, so this new book succeeds in making those pioneers who laid the foundations of the American explosives industry seem as real as contemporaries. Beginning with the intention of "skimming through" the book, the reader finds himself, willy-nilly, enjoying every word of the vicissitudes of the Laflin boys in the early nineteenth century, peddling powder for buttons, furs, or what-have-you, and almost sharing the anxiety of spunky Mrs. Dittmar as she sends her oldest boy out with a wagonload of dynamite to sell the quarrymen in upper New York.

Personally we wish the make-up man had been a bit more conservative in the arrangement of the cuts and cap-

tions, for our eyes have trouble distinguishing captions from text, and tire a little from following the short lines resulting from "run-arounds." Also, we regret the profusion of footnotes—not because of any antipathy for the breed, but because they subordinate and hide away such gems as the experience of Egbert Judson, who had no use for "theorists," among whom he classified all chemists, and who tried to remove the stickiness from his dynamite by heating it in an iron pan to "drive the nitroglycerine into the grains." The stickiness disappeared—with the factory. So many good stories, tucked away in the footnotes, together with the somewhat heterogeneous treatment of companies, personnel, processes and statistical data hint the magnitude of the authors' task in presenting, in orderly arrangement, a huge mass of information, culled from corporation files, personal reminiscences, government records, local histories and scattered documents of all kinds. Recognizing the immensity of their undertaking and appreciating the excellence of the result, makes any criticism seem picayune.

The work was inspired by, and published under the direction of the Institute of Makers of Explosives, which organization was extremely fortunate in obtaining Van Gelder and Schlatter for its creation. Van Gelder, who is responsible for the sections on dynamite, was superintendent of the old Forcite plant at Landing, and the Kenvil plant at the time the decree dissolving the du Pont Company assigned Forcite to Atlas and Kenvil to Hercules. He remained in charge of Kenvil until 1917 when he was called to Wilmington to become general manager of explosives plants. Schlatter, who is responsible for the sections on smokeless and high explosives, was superintendent of the Hercules Union plant in 1917 when he was placed in charge of the manufacture of smokeless. Both men have the broad background of technical and operating knowledge which is obvious on every page of their book. An introduction by Charles E. Monroe is, of course, a valuable and interesting feature of the book.

Physically, the volume is richly attractive, the type large, the illustrations profuse. As a history it is complete and authentic, but above all it is an absorbing romance of a great industry.

* * * *

Metallurgists' Manual

THE METALLURGISTS MANUAL. By *T. G. Bamford* and *Harold Harris*. D. Van Nostrand Company, New York 246 pages. Price, $4.

Reviewed by GILBERT E. DOAN

THE FIRST half of this book presents a selection of modern methods of chemical analysis for the common ores, slags and concentrates, and for the important industrial metals, including steel, iron and alloy steels. One section deals with the analysis of solid and gaseous fuels and of their heating values. This section also outlines methods for the examination of the physical properties of fire clays. The methods presented show careful selection from the most modern practices. The language is clear and concise and the instructions are easy to follow. It might be regretted that no references to more comprehensive treatises are made.

The second half of the book deals with smelting, pyrometry and metallography, with 40 pages of well-chosen tables at the end. The section on smelting explains the calculation of the charge and of the products for copper, lead and iron smelting. Dependable and convenient methods are shown for these calculations. The section on pyrometry is well balanced as between the theory of high-temperature instruments and their use. The authors incline toward the British types of instruments in their illustrations.

The balance between theory and practice in the section called Metallography is likewise good. The theory of the science, and the manipulations in preparing and photographing specimens, are clearly presented.

Any book of moderate size which attempts to treat several of the fields in a comprehensive science like Metallurgy faces great difficulties. Each field is more or less exclusively worked by specialists in that field. For a man just entering a new field or for the technical student, the "Manual" will be useful. It is well written and offers to those technically trained a brief and easy introduction to the present state of the sciences.

* * * *

STEEL AND ITS HEAT TREATMENT. By *D. K. Bullens*, Consulting Metallurgist. Third edition. John Wiley & Sons, Inc., New York. 564 pages. Price, $5.

This treatise is a material improvement over the previous edition as a result of rewriting and the inclusion of additional material. New chapters have been added on molybdenum steels and tungsten steels with a discussion of the inter-relation of tungsten, chromium and vanadium as applied to tool work. Uranium, zirconium and cerium steels are discussed in a new chapter, as are chromium steels, with a discussion of stainless and permanent magnet applications. An excellent chapter is added on electric equipment for heat treating, which is "largely the work of N. S. Stansel of the General Electric Company." The whole book is readable, thoroughly practical, interesting and nicely illustrated.

* * * *

Chromium Plating

STUDY OF PATENTS DEALING WITH THE ELECTRODEPOSITION OF CHROMIUM. By *Richard Schneedewind*. Engineering Research Bulletin No. 8 of the University of Michigan. 49 pages. Price, 50c.

This booklet does much to clarify the chromium plating patent situation. Practically every United States and foreign patent has been investigated and abstracted, with the comments and abstracts included. In the opinion of the author there are no patents or groups of patents which can control the deposition of chromium from chromic acid baths. In the light of unpatented, published researches many patents appear to infringe each other and attempt to describe prior art.

* * * *

A DIRECTORY OF APPLIED CHEMISTRY. Volume VII, Th—Z, with index. By *Sir Edward Thorpe*. Longmans, Green and Company, New York and London. 765 pages. Price, $20.50.

This volume (Thalenite to Zymurgy) completes the revised edition of this monumental work. To give any adequate summary of its contents is as obviously impossible as to estimate its value to the chemical profession and industry. Thorpe is the recognized encyclopedia of chemistry. Although its creator did not live to see the completion of this edition, he could not be other than satisfied with the way in which H. Foster Morley has carried on in his name.

Volume VII must not be dismissed without reference to the index to the whole work which occupies the last 150 pages of the last volume. Mr. Mickelthwait, the compiler, has apparently done a tedious job exceedingly well and with a minimum of errors.

READERS' VIEWS AND COMMENTS

An Open Forum

The editors invite discussion of articles and editorials or other topics of interest

Avoiding the Mistakes of the Other Fellow

To the Editor of Chem. & Met.:

Sir—I am in hearty accord with the unqualified approval given by you on page 465 of your August issue to the "Centralized Fact-Finding and Information Service" proposed by Dr. J. C. Dana. In my very early experience in wood distillation and wood waste utilization I quite naturally made certain basic mistakes and afterward consoled myself by thinking that no one need again fall into that particular hole. Great was my surprise when in a few years some of my fellow manufacturers proceeded to waste treasure only to learn that which had already been shown by me. Not that alone, but for thirty years I have stood aghast to see money out of count disappear in a very similar manner. One per cent of these preventable losses would be an ample compensation to enable me to checkmate them. Dr. Dana's plan looks like the needed medium.

Lake Wales, Florida. F. J. Root. Consulting Engineer.

* * * *

Parr's Product Not True Low-Temperature Coal Tar

To the Editor of Chem. & Met.:

Sir—Professor S. W. Parr's many friends will be glad to see evidence in Graham L. Montgomery's paper, "High Throughput Characterizes New Coking Process" in your November number, that Parr's investigation and study of many years on carbonizing Illinois coals are commencing to bear fruit.

I find myself in disagreement with but one statement made by Mr. Montgomery, viz.—"the by-products obtained from this process comprise about 20 gallons of a true low-temperature tar per ton of coal carbonized, etc., etc." If there is such a thing as true low-temperature tar it must be the primary tar products practically undecomposed by the temperature to which the vapors are exposed. Certainly tar which has been subjected to a retort temperature of 750 to 800 deg. C. is not a primary or true low-temperature tar.

The point is of more than academic interest because it is well understood by those familiar with working and sale of tar products that the general run of low-temperature tars can at present be safely credited with only fuel oil value, although research may result in finding a much more valuable outlet for them. The tar produced by the Parr-Layng process when worked in the ordinary way yields tar acids—creosote oils and pitch complying with existing standard specifications as shown in a paper by me—"A New Type of Tar Produced in Carbonizing Illinois Coal" (*Ind. & Eng. Chem.*, Vol. 19, page 31) in which is reported the results of analyses on four samples of tar produced in experimental runs at Urbana in 1926.

Professor Parr tells me that although tars from the new plant have not yet been completely analyzed, he does not hesitate to say that they are the same in type as the tars which I tested. He has also suggested that I send you this letter of comment.

New York, N. Y. S. R. Church. Consulting Chemist.

* * * *

Electric Rotary Calciner

To the Editor of Chem. & Met.:

Sir—In an article which appeared on page 697 of the November, 1927, *Chemical & Metallurgical Engineering*, entitled "Experimental Electrical Rotary Calciner," by our Mr. Murray, through an oversight on our part we neglected to state that this type of gypsum calciner was originally suggested to us by Dr. William Leon Ellerbeck of Salt Lake City, Utah. A statement to this effect in *Chemical & Metallurgical Engineering* will be appreciated.

George K. Burgess, Director.

Bureau of Standards,
U. S. Department of Commerce,
Washington, D. C.

* * * *

To the Editor of Chem. & Met.:

Sir—I have recently learned that it was by an oversight that my connection and the connection of my company with the development of the electric rotary calciner was not stated in Mr. Murray's article. As the publication of this article was not expected by me, there had been no occasion to mention the name of Lewis C. Karrick in connection with the device. In fairness then, incident to any correction you may make, please note that Mr. Karrick collaborated with me and lent valuable aid in the development of the device.

William Leon Ellerbeck, President.

Nephi Plaster and Manufacturing Co.
Salt Lake City, Utah.

* * * *

Vapor-Phase Refining for Vapor-Phase Cracking

To the Editor of Chem. & Met.:

Sir—Noting your remark on page 44 of the January, 1928, issue that one of the inherent disadvantages of vapor-phase cracking was "the production of a gasoline difficult to refine because of its higher content of unsaturated and gum-forming compounds," I would suggest that the answer to this problem in vapor-phase cracking is vapor-phase refining. (See *Chem. & Met.*, Dec. 22, 1924, pages 975-6.) There is no difficulty with vapor-phase cracked gasolines in vapor-phase refining.

Donald M. Liddell.

Consulting Engineer,
New York City.

Dissolving Drum Caustic

To the Editor of Chem. & Met.:

Sir—Caustic soda is so extremely soluble in water that I can see no appreciable advantage in L. C. Cooley's Drum Caustic Dissolver, described in the Plant Notebook section of the November number of *Chem. & Met.*, over the usual method of dissolving caustic by suspending the drum, with ends removed, just below the surface of the water.

In some plants where very large quantities of caustic are used a grating is placed in the tank on which to rest the drums so that they are held just below the surface of the liquid.

As the caustic dissolves, the part of the solution adjacent to the drum becomes heavier than the remainder and in settling effects a circulation which causes a rapid dissolving of the caustic. The use of steam is entirely dispensed with and the process requires no attention after the drums are in place. RAYMOND L. DREW.

Arlington, N. J.

EDITOR'S NOTE. Mr. Cooley's short note was written primarily to call attention to the desirability of removing caustic from its drums by dissolving rather than by attempting to break open the drums and to remove the contents in dry form.

* * * *

Unloading Tank Cars by Air Pressure

To the Editor of Chem. & Met.:

Sir — *Chemical & Metallurgical Engineering* for August, 1927 (page 506), includes an article under the above subject by L. G. Jones.

The author, in later correspondence, explains that this article represents "a chart for determining the air consumption for various operations; leaving the pressures used up to the unloader."

The Tank Car Committee of the Manufacturing Chemists' Association of the United States, has carefully reviewed the subject matter and wishes to comment on the following remarks by the author:

(a) Paragraph 1: "I was particularly interested in the time required to unload the cars and the quantity of air consumed.

(b) Paragraph 2, last sentence: "The higher the pressure on the acid, the more rapid will be the flow of the liquid through the pipe line to the plant storage tanks, thus decreasing the time required to empty the tank car."

(c) Paragraph 5: "One of the interesting features of these curves is the variation in compressed air consumed at different air pressures, this, of course, is compensated for in the saving of time in unloading, which may or may not be worth more than the extra air consumed."

Tank cars used for the transportation of sulphuric acid are subject to a test pressure of 60 lb. per sq.in. and are so stencilled on both sides of the tank. The pressure for unloading contents from such cars is not officially authorized, although the use of air pressure for unloading purposes, up to 30 lb. per sq.in. ($\frac{1}{2}$ the test pressure of 60 lb.) is considered within the limits of safety.

Some time ago, the Committee made an exhaustive investigation of the practice of unloading sulphuric acid tank cars by air pressure and discovered the use of excessive pressures in certain localities. Since that time, an educational campaign has been in progress, restricting the unloading pressure to 30 lb. per sq.in.

The industry, in general, is familiar with these requirements; however, the danger lies in the interpretation of the article referred to, by readers who may not be familiar with the requirements and who may conclude that the saving in time through the use of such unloading pressures is more economical than by restricting the pressure to 30 lb. per sq.in. and under.

The purpose of this letter is to point out that unloading pressures exceeding 30 lb. per sq.in. have not been authorized and should never be used for unloading sulphuric acid tank cars. TANK CAR COMMITTEE,

MANUFACTURING CHEMISTS' ASSN. OF THE U.S.

BY GEORGE E. TILEY, Chairman.

* * * *

American Investments In Foreign Chemical Industries

To the Editor of Chem. & Met.:

Sir—The foreign chemical industry is getting a lot of space in our daily press, mostly inspired, I should judge, by international bankers who, for their own reasons, are willing apparently to sacrifice American manufacturers in order to establish values for foreign industrial securities which they have underwritten.

This attitude seems to be reflected in Congress, indicated by the recent action of the Senate in passing a resolution to the effect that the tariff should be lowered, camouflaged with the explanation that agricultural interests demand it. The resolution, however, was promptly tabled in the House, I am glad to say.

Senator Pat Harrison—although a Democrat—referred to the international bankers' interest in this proposed lowering of the tariff in his speech on the subject in the Senate on January 9, and Senator Smoot—a Republican —has taken a similar position and is quoted as saying:

> It is significant that since about 1920 more than $10,000,000,000 in private American money has been loaned to foreign Governments and industrials; perhaps $6,000,000,000 to Europe alone. These private American investors are perfectly willing to have the tariff lowered in order that the European private debts owing them may be paid off by the sale of foreign manufactured goods in the markets of the United States. At the same time they appear to be perfectly willing to cancel the European war debts owing the United States Treasury, and now amounting to some $10,000,000,000. To these gentlemen with international minds American industries appear to be of secondary importance. I am forcibly reminded of that bit of Biblical wisdom: "Where your treasure is, there will your heart be also." Every million dollars of private American capital invested in European industrial securities is a powerful argument in favor of lowering the tariff.

German methods are well known in this country, i.e., to obtain footholds in foreign markets they will sell at or under cost to keep active their productive and selling forces. Now the German manufacturers, as well as the French and British manufacturers, have joined in forming powerful combinations, and Switzerland and Belgium will come in on this same program very shortly. We are expected to compete with these powerful organizations but are forbidden, by the Sherman Act, to combine our forces in this country to be prepared for the inevitable, i.e., the attack of these foreign combinations on American industry.

What action should we take to counteract this condition? JOHN F. QUEENY,

Chairman of the Board.

Monsanto Chemical Works,
St. Louis, Mo.

Selections from Recent Literature

LITHOPONE ZINC LIQUOR. W. N. Hirschel. *Chemiker-Zeitung,* Aug. 6, p. 599. The substance imparting a silky sheen to zinc liquor after the reduction stage of refining for lithopone manufacture has been identified. It is a hydrated basic zinc sulphate. Its formation should be avoided as far as possible, since it is insoluble and hence causes loss of Zn.

CHROMIUM PLATING. W. Pfanhauser. *Chemiker-Zeitung,* Aug. 10, pp. 605-6. The von Bosse process removes hydrogen gas before it affects the Cr deposit. There is no harmful temperature rise. The apparatus is described and illustrated.

DRYING OF OILS. Johannes Scheiber. *Zeitschrift für angewandte Chemie,* Nov. 3, pp. 1279-85. Much further study is needed, but in the present state of knowledge the combined chemical and colloidal theory of drying has much better support than the purely colloidal theory. It is even possible to make fairly reliable predictions of the behavior of an oil solely on the basis of its chemical nature.

CERAMIC WARE. Felix Singer. *Zeitschrift für angewandte Chemie,* Nov. 3, pp. 1295-6. Pyroton ware, having greater thermal stability than other varieties of stone ware, is now available in large scale apparatus. Experiments now under way show promise of great improvements in thermal and mechanical properties of thick ceramic ware.

WOOD TREATMENTS. Carl Schwalbe. *Zeitschrift für angewandte Chemie,* Oct. 20, pp. 1172-6. A lecture. Modern methods of utilizing wood waste include carbonization, glucose manufacture, making cellulose and paper pulp, and grinding (wood flour). Preservative treatments for structural prices are discussed.

NEW VAT DYES. H. T. Bucherer and Toshio Maki. *Berichte,* Oct., pp. 2068-78. In an investigation of the mechanism of the Skraup synthesis, a new class of vat dyes was discovered. These dyes are made from aminoanthraquinones and such compounds as nitrobenzene or the nitranilines. Brown, violet and black shades on cotton are among the effects produced by the new dyes.

RED LEAD. Heinrich Bestehorn. *Farbe und Lack,* Oct. 19, pp. 542-6; Oct. 26, p. 553; Nov. 2, pp. 565-8; Nov. 9, pp. 578-81. The properties of red lead as a paint pigment are discussed in the light of particle size and the packing arrangement (isodisperse or heterodisperse) in films. Rust prevention and the drying of linseed oil in red lead paints are also discussed. Photomicrographs are shown.

PETROLEUM REFINING. A. Guiselin. *Bulletin de la Societe de Chimie Industrielle,* July-Aug.-Sept., pp. 22-3. A brief description of the liquid SO_2 process and its advantages in separating aromatic from other hydrocarbons.

DE VECCHIS PROCESS. C. Scott Garrett. *Chemistry and Industry,* Nov. 4, pp. 1014-21. A juice flow sheet is shown to illustrate the working of the desiccation process of beet sugar manufacture. The advantages and economics of the process, and its relation to the diffusion process, are discussed.

CADMIUM PLATING. Jean Cournot and Jean Bary. *Comptes rendus,* Oct. 17, pp. 773-4. A coating of Cd is an excellent rust preventive. A little Cd also improves the performance and appearance (luster) of Ni plating.

WETTER EXPLOSIVES. P. Naoum. *Zeitschrift für angewandte Chemie,* Nov. 17, pp. 1351-9. Chemical structure and properties of the "wetter" type of explosives; development of their production and use in Germany; characteristics of the principal varieties of "wetter" explosives. Illustrated with detonation photographs.

NITROCELLULOSE. S. Kühnel Hagen. *Zeitschrift für angewandte Chemie,* Nov. 17, pp. 1359-61. Some alcohol-soluble nitrocelluloses were made, to study the influence of mercerization and other treatments before the cotton was nitrated. Under like nitration conditions the N-content of the product was the same, regardless of the previous history of the cotton. Some of the products gave clear films on glass, showing strong adhesion and cohesion.

ARTIFICIAL SILK. A. J. Hall. *Journal of the Textile Institute,* Nov., pp. P222-4. Action of swelling agents on viscose and acetate silks is discussed with reference to commercially important effects such as removing or restoring luster, modifying the dyeing properties, etc.

DRYING OF OILS. Johannes Scheiber. *Farbe und Lack,* Nov. 23, pp. 600-2. Anti-oxygens, which have been used successfully in rubber and other materials to control or retard oxidation and its effects, can also be utilized in the application of drying oils, e.g. in protective paints. By proper choice and use of the retarder, drying of the oil in a film can be controlled within desired limits, or entirely inhibited. The effect is more pronounced in linseed than in tung oil.

OIL RECOVERY. A. J. Broughall. *Chemistry and Industry,* Nov. 25, pp. 1096-9; Dec. 2, pp. 1112-6. A description of methods and equipment used in recovering spent lubricating oil by settling, extraction, centrifugal filtration, etc. Illustrated with photographs of apparatus.

HAVEG APPARATUS. F. Chemnitius, *Chemiker-Zeitung,* Dec. 28, pp. 1003-4. The low specific gravity (1.6), mechanical strength and great thermal and chemical stability of Haveg make it particularly suitable for use instead of chemical stoneware in apparatus for such reactions as are involved in the manufacture of salts of Br and I.

SCREENING. C. Cluett. *Industrial Chemist,* Dec., pp. 568-72. Illustrated description of equipment used for grading materials according to size. Photographs show a removable screen reel dresser, vibratory sifter, Hum-mer and Moto-Vibro screens. Difficulties encountered in screening are discussed.

ETHER. *Industrial Chemist,* Dec., pp. 573-7. Approved (British) practice in the manufacture of solvent ether (commercial grades) and ether for anesthesia is described. Plant layout is shown, and photographs are given of stills, fractionating columns and other equipment.

ETHYLENE GLYCOL. A. Bresser. *Kunststoffe,* Dec., pp. 276-7. A review of published literature on the manufacture of glycol, and its uses in which it replaces glycerol.

GLASS PIGMENTS. Harry Arndt. *Kunststoffe,* Dec., pp. 285-6. A review of methods use for obtaining given color effects in glass, and pigments used for specific purposes.

HIGH PRESSURES. E. B. Maxted. *Industrial Chemist,* Dec., pp. 527-9. Technique of high pressure reactions in chemical engineering; choice of alloys and other structural materials to withstand pressure; use of gages and meters; hazards and accident prevention.

PETROLEUM DISTILLATION. A. E. Dunstan. *Industrial Chemist,* Dec., pp. 533-8. Illustrated account of the design and use of pipe and shell stills in petroleum refining. Curves showing the course of distillation in the bubble tower are given.

LACQUERS. R. G. Daniels. *Industrial Chemist,* Dec., pp. 547-9. Some observations on preferred plant layout, machinery and storage equipment for the manufacture of nitrocellulose lacquers; illustrated.

LACQUERS. R. G. Daniels. *Industrial Chemist,* Dec., pp. 550-3. Notes on methods and equipment for grinding the pigments used in making lacquers. Single and triple roll mills, ball mills and an edge runner mill are described. Illustrated.

CRYSTALLIZING PLANT. Hugh Griffiths. *Industrial Chemist,* Dec., pp. 557-60. Illustrated description of the construction and use of a plant for crystallizing sugar, Glauber salt, Na sulphite and thiosulphate and the like, with particular reference to the Passburg plant (vacuum crystallizer).

MILK POWDER. *Industrial Chemist,* Dec., pp. 561-7. A description of methods and plant equipment used in the Milkal process of drying milk and preparing the powder for the market. Illustrated with photographs and diagrams

SUGAR REFINING. Jean Barbaudy. *Chimie et Industrie,* Dec., pp. 984-92. The significance and importance of pH in sugar refining are discussed. Methods and apparatus for measurement and control of pH, as applicable in sugar refining processes, are described. Illustrated.

GASOLINE FROM ALCOHOL. A. Mailhe and Renaudie. *Comptes rendus,* Dec. 27, pp. 1598-600. Among the many pyrogenetic reactions of the alcohols,

varying with catalyst and conditions, a peculiar and interesting case is the pyrolysis of primary alcohols in presence of uranous oxide. Among the products there is a considerable proportion of gasoline hydrocarbons (hexane to octane and hexene to octene).

HYDROPHENOLS. V. Grignard and G. Mingasson. *Comptes rendus,* Dec. 27, pp. 1552-6. In the catalytic hydrogenation of phenols, evidence indicates that Kekule's theory of benzene ring structure is correct insofar as the hydrogen addition behavior is concerned. The primary is a tetrahydrophenol involving the double bonds not contiguous to the OH group; next cyclohexanol is formed, and above the critical dissociation temperature of cyclohexanol conversion to cyclohexanone occurs.

CARBON DIOXIDE. J. R. Donald. *Canadian Chemistry and Metallurgy,* Jan., pp. 3-7. Development of the coke process and of the Backhaus purification process for CO_2 production, and their application in Canadian plants; uses of CO_2 in refrigeration, fire extinction, medicine and the industrial arts.

GINGER ALE. R. G. Skerrett. *Canadian Chemistry and Metallurgy,* Jan., pp. 9-14. Methods and equipment used in compounding, mixing, sterilizing, bottling, packing, storing and shipping ginger ale, with particular reference to Canada Dry. Illustrated with photographs.

NITRATING CELLULOSE. R. W. *Revue generale des matieres plastiques,* Dec., pp. 739, 741, 743. The Kaltenbach system for calculating the composition of nitrating acid is explained and discussed. A chart, illustrating Kaltenbach's use of modified triangular coordinates, is shown.

SYNTHETIC ACETIC ACID. Paul Pascal. *Revue generale des matieres plastiques,* Dec., pp. 745-55. Catalytic methods of oxidizing ethyl alcohol and/or acetaldehyde to acetic acid are described. The ternary catalyst Hg:Fe:V, catalysts containing Mn and some of the simpler mercuric catalysts are discussed, from the practical and theoretical standpoints. Electrolytic regeneration of spent catalysts is also considered.

CORK. W. de B. *Revue generale des matieres plastiques,* Dec., pp. 763-7. Production, processing and uses of cork are discussed. Grinding methods and machinery are considered in some detail. Illustrated.

GAS CEMENT. Julius Meyer. *Chemiker-Zeitung,* Jan. 4, pp. 4-5. Use of very finely powdered Al in making gas cement is impractical because of cost, and still more because the factors governing its behavior are not known and the results obtained cannot be accurately reproduced nor reliably predicted.

SODIUM FLUORIDE. Julius Mueller. *Chemiker-Zeitung,* Jan. 4, pp. 5-6. A short description of the manufacture of NaF by neutralizing HF with soda, separating the salt and drying it. The product is 95-98% pure, has a fine microcrystalline structure and meets all technical requirements. Part of the mother liquor is reused; the spent liquor is worked up into artificial cryolite.

DECOLORIZING CARBONS. P. Hoenig. *Chemiker-Zeitung,* Jan. 4, pp. 7-8; Jan 11, pp. 34-5. A description of the methods used in the manufacture of proprietary chars, such as eponite, norite, supranorite, purite, carbox, filtchar, suchar, nuchar, radite and carboraffin. Composition of these chars is discussed. Illustrated.

BLOOD GLUE. Hermann Stradlinger. *Chemiker-Zeitung,* Jan. 4, pp. 8-9; Jan. 11, pp. 35-6. A discussion of the manufacture of hide, casein and blood glues (special reference to blood glue), and their application to veneering and woodworking.

TUBE CRYSTALLIZERS. O. Zahn. *Chemische Fabrik,* Jan. 4, pp. 4-6. Illustrated description of the construction and operation of tube evaporators for controlled crystallization, for evaporating liquids, and for crystallization by evaporation. Provision is made for preventing incrustation in the case of salts having low transition points.

CHROME GREEN. R. Halle. *Farbe und Lack,* Jan. 4, pp. 7-10. The manufacture of the chrome greens is a process requiring skill and care. Procedures which give satisfactory results are described for the dry and the wet method. Photomicrographs of some of the products are shown. Some tests for quality are also described.

Government Publications

Prices indicated are charged by the Superintendent of Documents, Washington, D. C., for pamphlets. Send cash or money order; stamps and personal checks not accepted. When no price is indicated pamphlet is free and should be ordered from Bureau responsible for issue.

Phenol. Report of the United States Tariff Commission to the President of the United States. 5 cents.

Magnesite. Report of the United States Tariff Commission to the President of the United States. 5 cents.

The Establishment of Standard Grades for American Cotton Linters, by G. S. Meloy. Department of Agriculture Miscellaneous Publication 10.

Commercial Survey of the Southeast, by John M. Hager. Bureau of Foreign and Domestic Commerce, Domestic Commerce Series 19. $1.00.

A Burette for the Accurate Measurement of Gas Volumes Without Gas Connection to a Compensator, by E. R. Weaver and Martin Shepherd. Bureau of Standards Scientific Paper 559. 5 cents.

Density and Electrical Properties of the System, Rubber-Sulphur—Parts I and II, by A. T. McPherson, H. L. Curtis, and A. H. Scott. Bureau of Standards Scientific Paper 560. 15 cents.

Density of Hot-Rolled and Heat-Treated Carbon Steels, by H. C. Cross and E. E. Hill. Bureau of Standards Scientific Paper 562. 10 cents.

Thermal Expansion of Beryllium and Aluminum-Beryllium Alloys, by Peter Hidnert and W. T. Sweeney. Bureau of Standards Scientific Paper 565. 10 cents.

Some Vulcanizing Tests of Guayule Rubber, by D. Spence and C. E. Boone. Bureau of Standards Technologic Paper 353. 5 cents.

Controlling the Consistency of Enamel Slips, by W. N. Harrison. Bureau of Standards Scientific Paper 356. 15 cents.

Calibration and Adjustment of the Schopper Folding Tester, by F. T. Carson and L. W. Snyder. Bureau of Standards Technologic Paper 357. 10 cents.

Air-Hardening Rivet Steels, by Harry K. Herschman. Bureau of Standards Technologic Paper 358. 15 cents.

A Superheat Meter or Differential Thermometer for Airships, by D. H. Strother and H. N. Eaton, Bureau of Standards Technologic Paper 359. 10 cents.

Test Testing of Rubber Goods. Bureau of Standards Circular 38, 5th edition. 30 cents.

Manufacture of Lime. Bureau of Standards Circular 337 (Superseding Technologic Paper 16 under same title). 45 cents.

Alphabetical Index and Numerical List of United States Government Master Specifications, Promulgated by the Federal Specifications Board (Complete to June 10, 1927). Bureau of Standards Circular 319, 2d edition (Superseding Miscellaneous Publication 73).

Gases in Metals—III. The Determination of Nitrogen in Metals by Fusion in Vacuum, by Louis Jordan and J. R. Eckman. Bureau of Standards Scientific Paper 563. 10 cents.

United States Government Master Specifications on the following materials, issued under Bureau of Standards Circular numbers indicated: 358, Unlined Linen Fire Hose; 347, Sand-Lime Common Brick; 338, Bag Leather; 197, 2d edition, Indelible Marking Ink for Fabrics. 5 cents each.

Standards and Specifications in the Wood-Using Industries. Bureau of Standards Miscellaneous Publication 79. $1.50.

New Billet-Steel Concrete Reinforcement Bars. Bureau of Standards Commercial Standard No. 1. 5 cents.

Gases from Blasting in Tunnels and Metal-Mine Drifts, by E. D. Gardner, S. P. Howell, and G. W. Jones Bureau of Mines Bulletin 287. 20 cents.

Petroleum Refinery Statistics, 1926, by G. R. Hopkins. Bureau of Mines Bulletin 289. 20 cents.

Development of Some Fundamentals in the Ferric Sulphate-Sulphuric Acid Process, by F. S. Wartman and H. E. Keyes. Bureau of Mines Serial 2839.

Prevention of Hydrogen Sulphide Poisoning in Handling and Refining High-Sulphur Petroleums, by H. C. Fowler. Bureau of Mines Serial 2847.

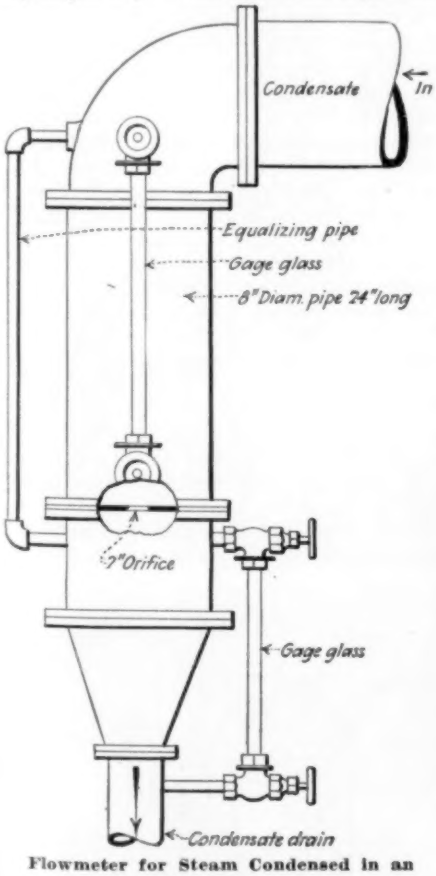
The Carburetion of Combustible Gas with Butane and Propane-Butane Mixtures with Particular Reference to the Carburetion of Water Gas, by W. M. Odell. Bureau of Mines Serial 2840.

THE PLANT NOTEBOOK
an exchange for OPERATING MEN

Condensate Flowmeter for Evaporators

By L. C. Cooley
Swenson Evaporator Company

A method for determining the falling off in evaporative capacity of evaporators, which involves only the reading of the height of the column of water in a gage glass, has been devised by A. L. Webre of E. B. Badger & Sons Company. This was used in one instance, in connection with a battery of six quadruple effect evaporators which were handling in the neighborhood of a million gallons of organic and scale forming liquid per day. This operation deposited



Flowmeter for Steam Condensed in an Evaporator

The meter is made up of ordinary pipe and fittings and may be attached directly to the condensate outlet of the evaporator. The sharp edged orifice is made of $\frac{1}{8}$ in. brass plate. The orifice may be calibrated by means of the ordinary hydraulic formula. The lower gage glass serves only to show if the condensate has a free fall below the orifice.

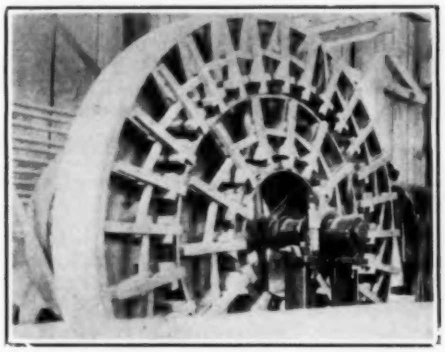
a gummy coating which, if removed in time, involved only the flushing out of the evaporator by circulating condensed steam. If, however, the scale was allowed to form for too long a time, it was necessary to use caustic soda for the washing which then took a considerably longer time. This, naturally, disrupted the operating schedule seriously.

An orifice meter such as is shown in the accompanying illustration, was attached to the condensed steam outlet of the first effect of each evaporator. When a clean evaporator was put into service, the level of the water above the orifice showed that steam was being condensed at the rate of 25,000 lb. per hour. It was found that when the steam condensing rate had decreased to 14,000 to 16,000 lb., in about sixteen hours, that the scale had formed to the practical limit for economical operation. However, the gage glass readings are ordinarily noted hourly and plotted. If the variation does not follow a standard curve closely, the machine is shut down for cleaning earlier than would ordinarily have been the case.

Agitating Wheel

By L. R. Raymond
Wallace, Idaho

In conducting leaching tests and solubility experiments, it is frequently necessary to have a means for keeping the solutions under examination constantly agitated. We have tried a number of methods, none of which proved satisfactory until the wheel shown in the accompanying illustration was built.



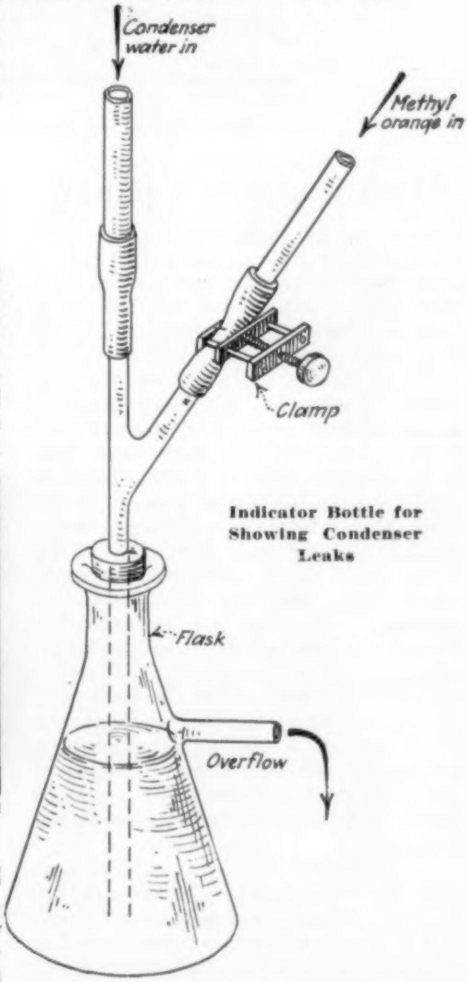
Wheel for Agitating Solutions

The wheel was made of wood, mounted on a 24 in. pulley with a 16 in. face. The superstructure is divided into 84 compartments arranged to hold the five-pint glass-stoppered bottles in which acids are sold. The bottles are held in place by means of small wooden bars which are tightened by means of screws. Stoppers are dipped in melted paraffine and tied to the necks of the bottles before agitating. The wheel is rotated at 15 r.p.m. by a 1-hp. motor. This permits the apparatus to be stopped at any time for removing of the bottles.

Detecting Condenser Leaks

By W. E. Callahan
Sharples Solvents Corporation

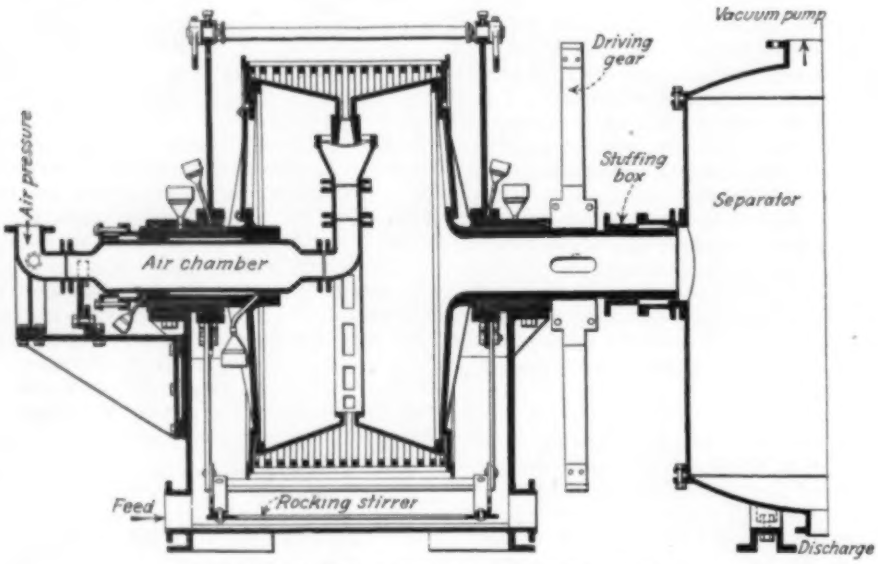
Leaks in condensers may go unnoticed for considerable periods if some ready means of detection is not provided. We have successfully used two methods depending upon the acidity of the condenser water which are simple and easily applied. One is illustrated herewith. A $\frac{1}{4}$-in. line from each condenser discharge is run to a separate glass bottle provided with an overflow. Methyl orange is slowly dripped into each bottle with the condenser water, indicating any increase in acidity.



Indicator Bottle for Showing Condenser Leaks

The second method, perhaps more reliable, consists in placing two electrical contacts in the discharge of each condenser. Each pair of contacts may be plugged into a galvanometer located at a central switchboard. The galvanometer may then be used to measure any change in conductivity of the condenser water due to a leak.

EQUIPMENT NEWS *from* MAKER *and* USER



Joubert and Goslin Heavy Duty Vacuum Filter

High Capacity Vacuum Filter

A new heavy-duty vacuum filter is now being produced by the Joubert & Goslin Machine & Foundry Co., 82 Beaver St., New York City.

The principle of the new filter is clearly shown in the accompanying cross-sectional view. The machine consists of a slatted drum with filter cloth on its circumference. The drum revolves slowly on its horizontal axis with the lower part of the filter submerged in the material to be filtered. The inside of the drum is divided into compartments which open into the central suction chamber. The chamber is connected through a large hollow drive shaft to a separator and vacuum pump. The material which is deposited on the surface of the filter cloth in the operation of the filter is partially dried by suction during a considerable portion of the revolution of the drum. A knife removes the cake at a point just above the liquor level on the down side.

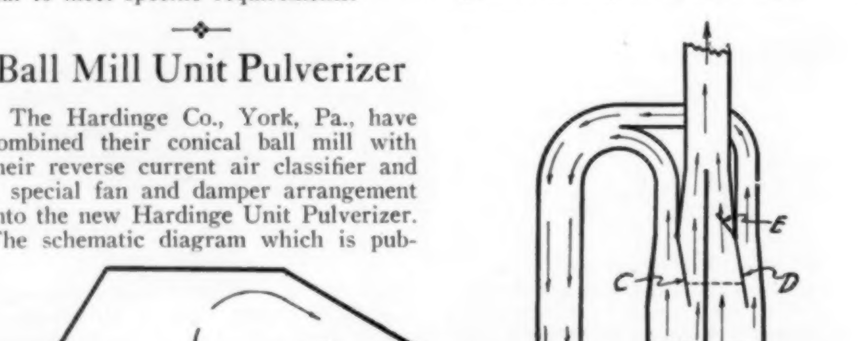
A sliding valve shown in conection with the air chamber runs through the left-hand trunnion and permits air pressure to be put on one compartment at a time. Depending upon the type of operation required by the material being filtered, the valve may be arranged to blow the cake or the cloth at any point in the cycle. In some cases the cake is blown off just before it comes to the knife. In others, the filter cloth is blown directly after the knife, or the cloth may be washed by maintaining suction until the surface is again submerged, and then by an application of pressure the compartment is blown out, giving a thorough flushing during each revolution.

The design of the filter is such as to permit large capacities through the virtual elimination of obstructions to the easy flow of filtrate and air. Consequently, the makers claim that very little power is required for the vacuum pump in proportion to the output. They state that the filter is particularly adapted for use in such industries as cement, alkali, paper, sugar, salt, mining operations and lime recovery. The filter, while ordinarily constructed almost wholly of cast iron, may be supplied in any material to meet specific requirements.

Ball Mill Unit Pulverizer

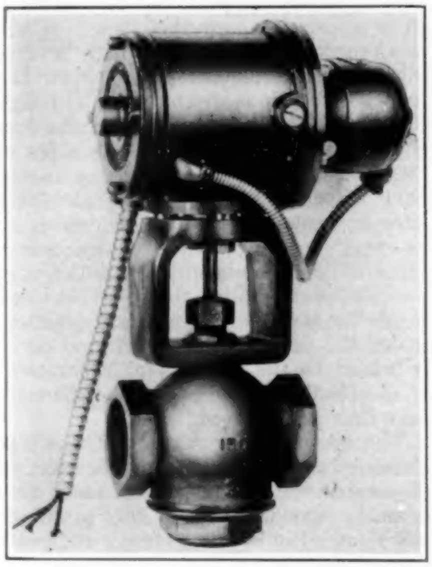
The Hardinge Co., York, Pa., have combined their conical ball mill with their reverse current air classifier and a special fan and damper arrangement into the new Hardinge Unit Pulverizer. The schematic diagram which is published herewith indicates the operation of the new unit. At the left is indicated the ball mill with coal entering from the open end. At the right are the fans which control circulation of make-up air and of the pulverized coal. Entrance for the air is at the extreme right. Above the fans are the recirculation pipe, the make-up air pipe, the dampers and the conduit leading to the fire box. Fan *A* draws the pulverized coal from the mill and, depending upon the position of *C*, recirculates the coal through the mill or discharges it through the up-take. Damper *B* is arranged to operate with damper *C* so that when they are in the extreme right position, all of the coal is returned to the mill, and all of the make-up air is sent to the furnace. In the extreme left position, all of the air is sent to the mill and all of the coal to the up-take. By proper adjustment of the damper any condition between these extremes may be realized, and thus the fineness of the coal and the proportion of make-up air may be controlled. An auxiliary damper *E* is arranged to operate with *D* so as to control the air which is sent directly to the furnace.

In actual practice the fans are combined into a single duplex fan wheel in a casing having a vertical diaphragm. The diverting vanes are located in a similarly divided housing having outlets for connection to the mill return pipe and the fuel pipe to the furnace. The diverting vanes are connected together so that they are moved simultaneously. The same operation which sets the vane may be made to control the raw coal feeder. The apparatus may be manually regulated or may be interconnected with



Schematic Diagram Showing the Principle of the Hardinge Unit Coal Pulverizer

any of the standard systems of automatic control. It is claimed that the flow of fuel with this system may be instantaneously varied within the limits of the equipment, without stopping the mill or damaging the apparatus. It is further stated that no magnetic separator is required. Units are obtainable in sizes ranging in capacity from 175 lb. to 25 tons per hour.



Bristol Remote Controlled Valve

Motor-Operated Valve

The Bristol Co., Waterbury, Conn., has introduced what they refer to as their new type B-K valve. This is a remote controlled electric motor-operated valve intended for steam, water and compressed air.

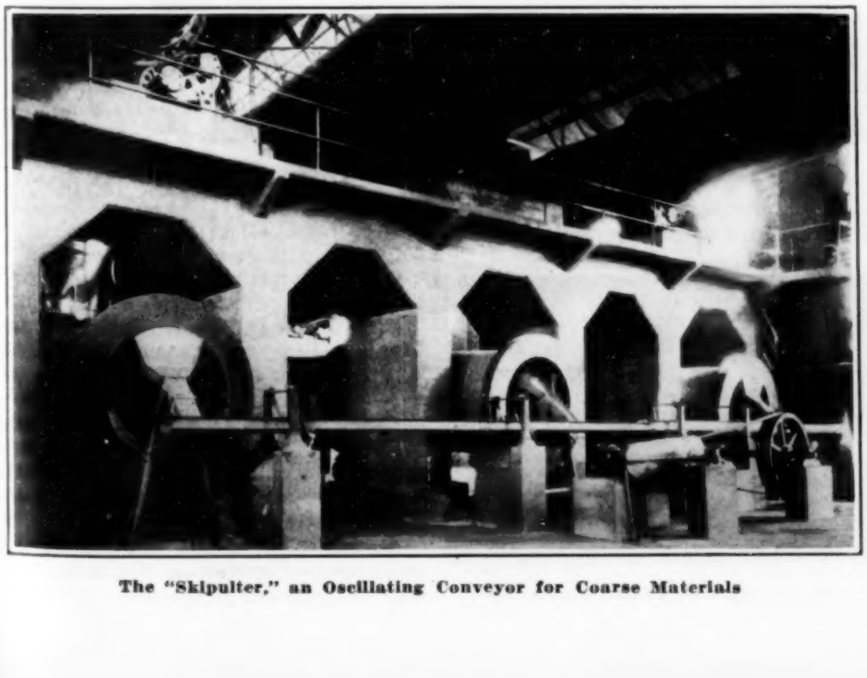
As is shown in the illustration, a heavy bodied standard globe valve is used, with the operating mechanism mounted some distance above it. This prevents the motor and mechanism from becoming unduly heated by the steam in the line. The valve is cam-operated through a train of cut spur gears driven by the motor. The opening and closing cycles of the valves amount to 12 sec. each. A limit switch clears the motor circuit when the operation of opening or closing the valve has been completed. The switch is actuated from the main camshaft, and brings the valve either into the fully opened or closed condition.

The valve may be supplied in sizes ranging from $\frac{1}{2}$ to $2\frac{1}{2}$-in., and for pressures from 150 lb. in the smaller sizes to 75 lb. in the larger. Any standard motor requirements may be met. The valve is said to be particularly adapted to installation on steam lines to dry kilns, sizing tanks, dye vats and similar purposes, or for the control of water supply or level in process storage tanks and for heating and cooling purposes.

Oscillating Conveyor

An oscillating conveyor which has been used to the present only in cement mill installations, is being produced by F. L. Smidth and Company, 50 Church St., New York. This conveyor is called the "Skipulter." It consists, as is evident from the illustration reproduced herewith, of a slightly inclined trough suspended by means of pendulums, and given an oscillating motion by means of a flywheel and eccentric. The intermittent forward and backward motion which results, causes the material which is supplied to the trough to be shaken gradually toward the lower end where it is discharged.

The Skipulter is adapted primarily to the handling of cement clinker, coal, ore, rock, slag, limestone and other coarse materials. It is claimed to be of particular use in the handling of hot materials which make conveying ordinarily difficult. The power consumption is said to be less than that required for the usual conveying methods. Low maintenance and simple operation are further advantages which are claimed.

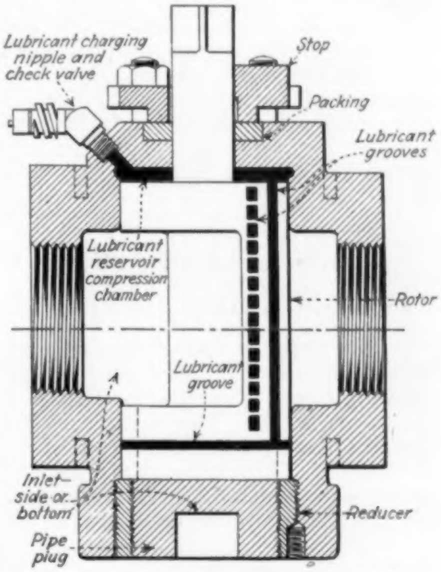


The "Skipulter," an Oscillating Conveyor for Coarse Materials

Lubricated Quarter-Turn Rotary Valve

A new rotary lubricated valve has been introduced by MacGregor & Harcourt, Railway Exchange Bldg., St. Louis, Mo. It is known as the "MacGregor" and is of the quarter turn type. It is characterized as "free operating" and "positive sealing."

The construction of the valve is indicated in the cross-sectional view shown herewith. It consists of a heavy body in the form of a cross with pipe-threaded openings on three sides. The fourth side is closed except for an opening through which the shank of the rotor projects. The body is bored cylindrical and is fitted with a thin walled hollow cylindrical rotor. The mid-section of the rotor is cut away to provide a passageway through the valve. About half of this section is removed. The rotor is closed at the shank end, but open at the bottom so that the valve may be used either for an angle hookup or for straight line work. This change is made simply by removing the pipe plug shown in the valve bottom and screwing it into the right-hand port of the body.



MacGregor Lubricated Rotary Valve

The land portion of the rotor carries lubricant grooves which communicate at the top with a lubricant reservoir and at the bottom with a ring groove. The lubricant is supplied under pressure to the reservoir through any desired type of grease fitting. Line pressure on the rotor is transmitted to the lubricant in the reservoir, forcing the material into the grooves and supplying a positive seal. When the valve is closed in straight-line service there is a proove sealing the rotor on either side of the discharge port. Similarly when used for angle service, the ring groove provides a continuous seal.

It is claimed that because of the floating feature of the rotor, the valve is fully self-lubricating. The height to which the shank extends from the valve is an indication of the amount of lubricant in the reservoir. It is further claimed that

the pressure on the rotor is communicated without appreciable diminution to the lubricant in the grooves, thus balancing the line pressure and further improving the seal. Three types of viscous, insoluble lubricants have been developed which are said to cover practically all industrial conditions. The valves may be provided in all the usual smaller and medium sizes, in 150-lb. cast iron or semi-steel. Valves of special metals and special multiport construction can be supplied.

In addition to the claims which have been made above, the manufacturers state that the valves are subject to easy repair as all parts for a given size are interchangeable without grinding or fitting. The valve is said to be easily turned and fully tight under all conditions.

Steam Operated Temperature Controller

A new type of steam-operated controller has recently been placed on the market by the C. J. Tagliabue Mfg. Co., Brooklyn, N. Y. The main valve is operated by a portion of the steam which it controls. The temperature of the apparatus to which the steam is supplied governs the control force of the steam,

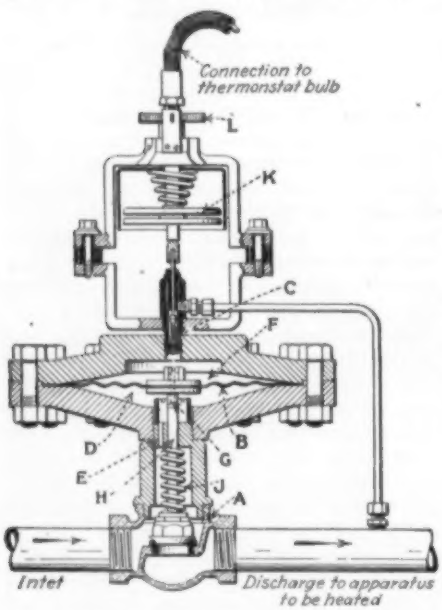


Fig. 1—Cross Sectional View of the Tagliabue Steam Operated Controller

through a thermostatic element. Fig. 1 shows a cross-section of the controller, while the assembled apparatus, together with the thermostat bulb is shown in Fig. 2.

The operation of the controller is easily demonstrated in connection with Fig. 1. Steam is admitted from the inlet side of the valve into chamber *D*, and into *F* through the small orifice *G* in the valve spindle *H*. The pressure is balanced on both sides of the diaphragm *B* and the spring *J* holds the valve closed until the steam is permitted to escape through the valve *C* more rapidly than it is admitted to chamber *F* through

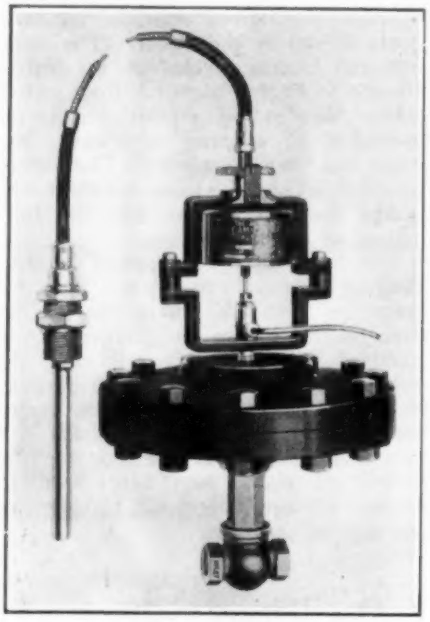


Fig. 2—Tagliabue Steam Operated Controller

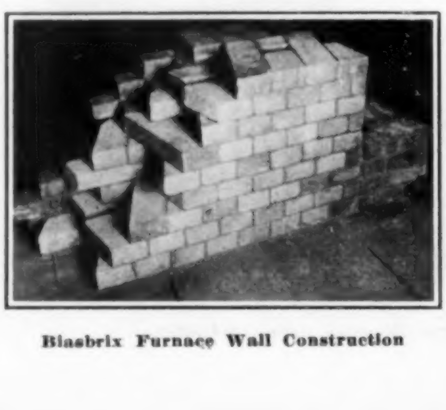
orifice *G*. When the valve *C* is opened by the thermostat working in connection with the bellows *K*, the differential pressure exerts an upward force on the diaphragm and opens the valve against the pressure of the spring. The amount of opening of the pilot valve *C* thus controls the opening of the main valve *A* through its entire range.

Adjustment of the pilot valve *C* may be made within the range of the controller by means of the knurled knob *L* at the top of the controller head.

The controller, which is supplied in the form shown, as well as in a type in which the controller head is mounted at a convenient point remote from the valve, is designed to operate between 5 and 100 lb. pressure. Each instrument has a temperature-controlling range of 40 deg. and may be supplied with this range anywhere between the limits of 95 and 290 deg. F. The valve is supplied in sizes ranging from ½ to 4 in.

Interlocking Refractory

A new firebrick shape is now being produced by the General Refractories Co., Philadelphia. These refractories are known as Biasbrix, and get their name from the fact that they are laid up on the bias, one brick overlapping and tying together three other Biasbrix in a self-locking construction which is said to



Biasbrix Furnace Wall Construction

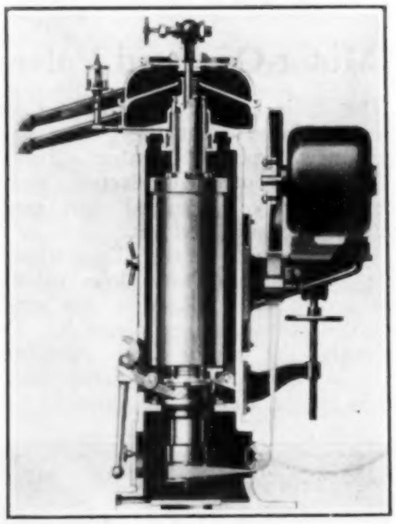
give tight joints and a strong wall. The illustration makes the construction evident.

Clarifier and Separator

The "Positive Machinery Division" of the National Acme Co., Cleveland, Ohio, has recently introduced a new centrifugal separator which may, when necessary, easily be converted into a clarifier.

Material is supplied to the machine from above through the center of the bowl in which it flows through several tubes for a total travel of about 100 inches before it is discharged. Through the action of centrifugal force, the foreign matter is deposited at the sides of the tubes and is held back by means of dams of suitable height. The tubes may later be removed for cleaning which is, however, usually not of frequent occurrence. When the machine is to be used as a clarifier, a filter sleeve is provided inside the bowl so that a filtering action, under the influence of centrifugal force is added to the centrifugal separation. It is said that exceedingly fine material may thus be removed.

The manufacturer states that this machine is adapted to the purification of oils and to the clarification of varnishes, enamels and lacquers. The machines are supplied in both stationary and portable types.

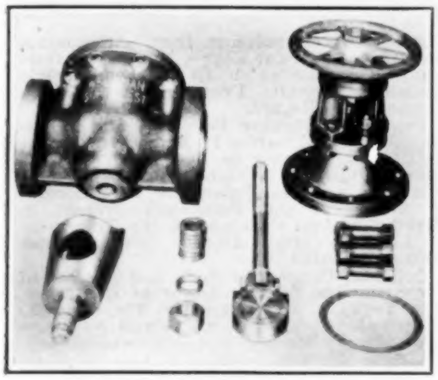


"Positive" Clarifier and Separator

Valves for Severe Conditions

The accompanying illustration shows the principal parts of the new Wellman "Super-Test" gate valve made by the Wellman-Seaver-Morgan Co., Cleveland, Ohio. Valves of this type are also made in the globe pattern. They are intended for high-pressure and high-temperature service, and as such are constructed of forged and stainless steel. The latter material is used where the danger of erosion is great.

As indicated in the illustration, the most notable feature of the valve consists of a tapered removable valve-cage,

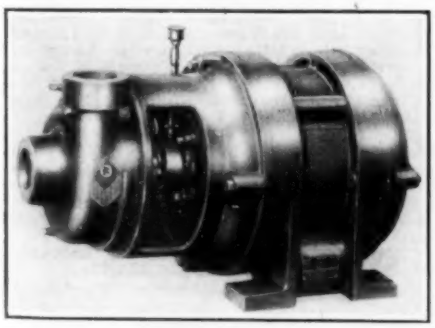


Wellman "Supertest" Gate Valve

which may be turned through 90 deg. and locked in position to shut off the line when work is being done on the valve. Adjustment of the cage may be made from the outside. The cage is easily removable for repairs or replacement. The globe valves are supplied in sizes from ½ to 3 in. Gate valves are made in sizes from 1 to 6 in.

Motor-Pump Unit

The Allis-Chalmers Mfg. Co., Milwaukee, Wis., have developed what they call their Type "SSU" Centrifugal Pumping Unit, which combines a motor and centrifugal pump on a single base with a common shaft. The pump impeller and the armature are mounted on the

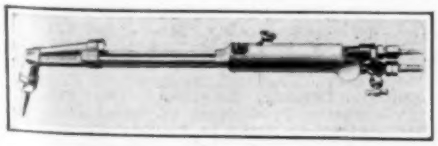


Unit Motor-Pump

same shaft which runs in tapered roller bearings carrying both thrust and radial loads. The pump casing is bolted direct to an extension of the motor end housing. The units are supplied in capacities of from 25 to 200 g.p.m. for pumping against heads of from 50 to 100 feet.

New Cutting Blowpipe

A new cutting blowpipe designed as type C-14 has recently been introduced by the Oxweld Acetylene Co., New York City. The blowpipe is provided with interchangeable nozzles for use with medium or low pressure gas.



Oxweld C-14 Cutting Blowpipe

Manufacturers' Latest Publications

Foote Bros. Gear and Machine Co., 215 North Curtis St., Chicago, Ill.—New catalog covering friction clutches and transmission machinery, as manufactured by the A. Plamondon Manufacturing Co.

Allis-Chalmers Co., Milwaukee, Wis. — Bulletin 1826—Covering Cyanide plant equipment.

Leeds and Northrup Co., 4901 Stenton Ave., Philadelphia, Pa.—Price list and apparatus index; new pamphlet on metered combustion control at Providence, R. I.

Parks-Cramer Co., 8102 Old South Bldg., Boston, Mass.—Leaflet on jacketed pipe and fittings.

U. S. Electrical Manufacturing Co., Los Angeles, Calif.—Folder describing the use of "Asbestosite" insulation for motors.

American Manganese Bronze Co., Holmesburg, Philadelphia, Pa.—Technical data sheets regarding the uses of Hy-Ten-Sl bronze in various industries.

Denver Fire Clay Co., Denver, Colorado. —Folder describing Latite refractory cement.

Homestead Valve Manufacturing Co., Homestead, Pa.—Catalog No. 34—New Catalog describing the complete line of Homestead valves; also a folder on the "Hy-pressure Jenny," a new rapid portable steam generator.

Worthington Pump and Machinery Co., 115 Broadway, New York, N. Y.—Bulletin WP-1000—Equipment for Railways.

The Fred Goat Co., Inc., 314 Dean St., Brooklyn, N. Y.—Mailing piece describing the machinery production facilities of this company.

Honeywell Heating Specialties Co., Wabash, Ind.—New pamphlet describing the Honeywell Electric Gas Valve.

Cleveland Crane and Engineering Co., Wickliffe, Ohio.—Form No. TR-553—Cleveland Electric Tramrail Systems.

Baker Co., Inc., Newark, N. J.—New booklet on fine wires.

Laclede-Christy Clay Products Co., St. Louis, Missouri.—Folder on fire brick.

Palo Co., 153 West 23rd St., New York, N. Y.—Pamphlet on apparatus for industrial and laboratory use.

Hagan Corp., Bowman Bldg., Pittsburgh, Pa.—Folder on the Hagan Steam Purifier.

Westinghouse Electric & Mfg. Company, East Pittsburgh, Pa. — Complete new Westinghouse catalog of electrical supplies for 1928 to 1930.

Beach-Russ Company, 50 Church Street, New York, N. Y.—Bulletin No. 36—Bulletin describing this company's line of rotary pumps and blowers for pressure and vacuum service.

The Ajax Electrothermic Corporation, Ajax Park, Trenton, N. J.—Bulletin 4—A complete description of "Ajax-Northrup" electric furnaces.

Fuzon Welding Corporation, 103rd St. and Torrence Ave., Chicago, Ill.—New folder on Fuzon arc welders.

American Mond Nickel Company, Pittsburgh, Pa.—A booklet which describes the production of Mond nickel pellets.

Laclede-Christy Clay Products Company, 1711 Ambassador Bldg., St. Louis, Mo.—New mailing piece on fire brick.

Struthers-Wells Company, Warren, Pa.—Bulletin 10—Heat exchangers for oil refineries, process works and power and byproduct coke plants.

U. S. Stoneware Company, Akron, Ohio. —Bulletin 302—Acid proof containers and developing tanks.

Stone and Tar Products Company, 97 So. Sixth St., Brooklyn, N. Y.—Booklet on products for structural repairs and plant maintenance.

American Asphalt Paint Company, 844 Rush Street, Chicago, Ill.—Booklet "In the Long Ago," describing the early days of the Gilsonite asphalt industry.

Nashville Industrial Corporation, Old Hickory, Tenn. — Bulletin 11 — Conoidal fans, blowers and exhausters.

Torchweld Equipment Company, 224 North Carpenter St., Chicago, Ill.—Catalog 28—Gas cutting and welding equipment.

Boiler Engineering Company, 931 Federal Trust Bldg., Newark, N. J.—New folder on "Beco" baffles.

The Electric Controller & Mfg. Company, Cleveland, Ohio—A mailing piece describing the company's new Type SA lifting magnet.

The Esterline-Angus Company, Indianapolis, Ind.—Bulletin 1127—The new E-A time recorder.

Roller-Smith Company, 233 Broadway, N. Y.—Bulletin 580 — Inclosed circuit breakers.

The Connersville Blower Company, Connersville, Ind.—Supplementary bulletin 43 —Small capacity Connersville meters.

The Foxboro Company, Inc., Foxboro, Mass.—Folders and mailing pieces as follows: Bulletin 143-2, Foxboro Tachographs; Folder No. DMF 513, Foxboro Instruments; Folder No. DMF 546, "Heat on a Spree."

Semet-Solvay Engineering Corporation, 40 Rector St., New York, N. Y.—Pamphlets as follows: No. 316, Semet-Solvay Coke Ovens; No. 329, Budget Planning; No. 332, Coke Oven Simplicity; No. 336, Coke Ovens; No. 337, Index of Literature on Semet-Solvay and Steere Equipment and Processes.

Philadelphia Quartz Company, Philadelphia, Pa.—Form No. 24—Silicate of Soda Cements.

Armco Culvert Mfg. Association, Middletown, Ohio—New bulletin on Armco Paved Invert Culverts.

Crescent Refractories Company, Curwensville, Pa.—Technical bulletin No. 17—Fire Clay Mortar.

The Denver Fire Clay Company, Denver, Colo.—Bulletin 140—Refractories; mailing pieces on Assay Furnaces and "Hifire" Bricks and Bond.

De Laval Steam Turbine Company, Trenton, N. J.—Form E-1115—De Laval Pumps at Haverhill, Mass.

H. H. Robertson Company, First National Bank Bldg., Pittsburgh, Pa.—Folder on Robertson Protected Metal.

National Flue Cleaner Company Inc., Groveville, N. J.—New bulletin on the "National Soot Blower for Return Tubular Blowers."

The Brown Instrument Company, Philadelphia, Pa.—New pamphlet on "How the Other Fellow Does it."

The Timken Roller Bearing Company, Canton, Ohio—"The Truth About Anti-Friction Bearings."

General Electric Company, Schenectady, N. Y.—Bulletins and publications as follows: G.E.C.-40A, Welding Electrode; G.E.A.-61A, Constant-Speed Direct-Current Motors; G.E.A.-63A, Type G.T.E. Motors; G.E.A.-150A, the Electric Division of the C. M. & St. P. R.R.; G.E.A.-189A, Automatic Switching Equipment; G.E.A.-528A, Centrifugal Air Compressors; G.E.A.-529A, Low Speed Synchronous Motors; G.E.A.-532A, Electric Heating Equipment for Stereotype Metal Furnaces; G.E.A.-545B, Automatic Supervisory Equipment, Selector Type; G.E.A.-570A, Hand Starting Compensators; G.E.A.-572, Automatic Switching Equipment; G.E.A.-732A, D & W Oil Fuse Cutouts; G.E.A.-748A, Outdoor Station Equipment; G.E.A.-761A, Improved Brush-Holders; G.E.A.-823, Atomic Hydrogen Arc Welding Equipment; G.E.A.-841, Magnetic Switch; G.E.A.-847, Induction Differential Relays; G.E.A.-855, Electric Drive for Motor Buses; G.E.A.-858, Low-Speed Direct-Current Generators; G.E.A.-859, Current Differential Relays; G.E.A.-862, Demand Meters; G.E.A.-875A, Type WD-300A Arc Welder; G.E.A.-880, Protective Panels; G.E.A.-891, Mine Fan Equipment; G.E.A.-892, Motor Drives for Centrifugal Pumps; G.E.A.-893, Electric Drive for Coal and Ore Hoists; G.E.A.-896, Oscilloscopes; G.E.A.-903, Demand Meters; G.E.A.-910, Removing and Replacing Pinions.

International Combustion Engineering Corp., 200 Madison Ave., New York, N. Y.—Catalog DQ-2—The Sulzer System of Dry Coke Quenching.

Combustion Engineering Corporation, 200 Madison Ave., New York, N. Y.—Reprint on "The Design of Furnaces for Pulverized Coal."

International Coal Carbonization Company, 200 Madison Ave., New York, N. Y.—Catalog KSG 2—The KSG Process of Low Temperature Carbonization of Coal.

American Fluid Motors Company, Philadelphia, Pa.—Calalog C—A new catalog which describes Hele-Shaw Hydraulic Pumps and Motors.

The Horace R. Whittier Company, Pequabuck, Conn.—New bulletin on vitreous enamelling and enamelled dials.

Erie City Iron Works, Erie, Pa.—New folder on the Erie City "Vortex" Furnace. Also a pamphlet on "Some Fundamentals of Water Cooled Furnace Design."

Daniel Woodhead Company, Chicago, Ill. —Folder describing the "Protex" Rubber Handled Extension Lamp.

Deiser Concentrator Company, Fort Wayne, Ind.—Booklet on the "Leahy" vibrating screen.

The Superheater Company, 17 East 42nd Street, New York, N. Y.—A supplement to the sixth revised edition of "Superheat Engineering Data."

PATENTS ISSUED

Jan. 3 to Jan. 24, 1928

Paper, Pulp and Sugar

Process for the Production of High Alpha-Cellulose Fiber. George A. Richter, Berlin, N. H., assignor to Brown Company, Berlin, N. H.—1,654,603.

Paper-Making Machine. Charles W. Valentine, Watertown, N. Y., assignor to The Bagley and Sewall Company, Watertown, N. Y.—1,656,766.

Process of Treating Bagasse-Fibers Preparatory to Pulp Board Making. Herbert Theodore Price, Sydney, New South Wales, Australia.—1,656,829.

Paper Machine. Harry D. Bean, Montreal. West Quebec, Canada.—1,656,853.

Rubber, Rayon and Synthetic Plastics

Apparatus for Dehydrating Viscose Products. Samuel A. Neidich, Edgewater Park, N. J.—1,654,553.

Process for Precipitating Artificial Threads, Ribbons, Films, and the Like of Viscose. Adolf Kämpf, Premnitz, Germany. —1,654,818.

Process for Recovery of Poisonous Gases in Viscose Manufacture. Frederick Carl Niederhauser and Hayden Benjamin Kline, Cleveland, Ohio, assignors to The Industrial Fibre Company, Cleveland, Ohio.—1,655,709.

Process for the Renewing of India Rubber and Chiefly of that which is Contained in the Covers of Worn-Out Pneumatic Tires. Charles Danier, Paris, France, assignor to Syndicat Franco-Neerlandais, Paris, France.—1,656,694.

Vulcanization of Rubber. Winfield Scott, Akron, Ohio, assignor to The Rubber Service Laboratories Company, Akron, Ohio.—1,656,834.

Method of and Apparatus for Vulcanizing Rubber Articles. Robert W. Snyder, Akron, Ohio, assignor to The Goodyear Tire & Rubber Company, Akron, Ohio.—1,656,874.

Process of Reclaiming Rubber. George J. Miller, Douglas, Ariz.—1,657,171.

Method of Making Compound Cellulose-Ester Plastic. Karl W. Monroe, North Arlington, N. J., assignor, by mesne assignments, to Du Pont Viscoloid Company, Wilmington, Del.—1,657,172.

Petroleum Refining

Oil-Cracking Apparatus. Frank C. Van de Water and Frederick R. Sunderman, Newburgh, N. Y., assignors to Petroleum Laboratories Inc., Newburgh, N. Y.—1,655,030.

Method and Apparatus for Treating Petroleum Oil. Aubrey D. David, Chicago, Ill., assignor to The Universal Oil Products Company, Chicago, Ill.—1,655,596.

Process of Distilling Petroleum Oil. Richard Wright Hanna, Piedmont, Calif., assignor, by mesne assignments, to Standard Oil Company of California, San Francisco, Calif.—1,655,603.

Treating Oils. Arthur F. L. Bell, San Francisco, Calif., assignor to Associated Oil Company, San Francisco, Calif.—1,655,890.

Process for Breaking Petroleum Emulsions. Melvin De Groote, St. Louis, and Wilbur C. Adams, University City, Mo., assignors to Wm. S. Barnickel & Company, Webster Groves, Mo.—1,656,623.

Refining Oils. Edward A. Rudigier, Baltimore, Md., assignor to Standard Oil Development Company.—1,656,710.

Control of Pyrolytic Conversion. James Raymond Carringer, Hillside, N. J., assignor to Standard Oil Development Company.—1,656,724.

Producing Gasoline from Natural Gases. Elmer B. Bird, Little Rock, Ark.—1,656,813.

Process of Refining Oil. John C. Black, Los Angeles, Calif.—1,656,997.

Process of Desulphurizing and Purifying Petroleum Oil. Roy Cross, Kansas City, Mo.—1,654,581.

Conversion Apparatus for Refining Hydrocarbon Materials. Russell K. Collins, Fort Worth, Tex., assignor, by direct and mesne assignments, to Collins Process, Inc., Wilmington, Del.—1,654,577.

Expansion Process and Apparatus for Refining Hydrocarbon Materials. Russell K. Collins, Fort Worth, Tex., assignor, by mesne assignments, to Collins Process, Inc., Wilmington, Del.—1,654,578.

Expansion Process and Apparatus for Refining of Hydrocarbons. Russel K. Collins, Fort Worth, Tex.—1,654,580.

Method of Distilling Hydrocarbons. William M. Duncan, Alton, Ill.—1,654,797.

Treating Hydrocarbons. Alfred Schwarz, Montclair, N. J., assignor by mesne assignments, to Coal and Oil Products Corporation, New York, N. Y.—1,655,741.

Apparatus for Treating Hydrocarbons. Gustav Egloff and Harry P. Benner, Independence, Kans., assignors to Universal Oil Products Company, Chicago, Ill.—1,655,600.

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>
> *Complete specifications of any United States patent may be obtained by remitting 10c. to the Commissioner of Patents, Washington, D. C.*
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> *Photostatic copies of foreign patents may be obtained at the same address, prices on application.*

Organic Processes

Process for the Chlorination of Saturated Hydrocarbons. Erich Krause and Koloman Roka, Konstanz, Germany, assignors to Holzverkohlungs-Industrie Aktien-Gesellschaft, Konstanz, Badenia, Germany. —1,654,821.

Process of Producing Acetone and Butyl Alcohol by Fermentation. Edwin F. Pike, Chester, and Henry F. Smyth, Wayne, Pa., assignors, by mesne assignments, to Commercial Solvents Corporation.—1,655,435.

Apparatus for and Process of Explosion Fibration of Lignocellulose Material. William H. Mason, Laurel, Miss., assignor to Mason Fibre Company, Laurel, Miss.—1,655,618.

Process for the Manufacture of Cellulose Acetate. Leonard Angelo Levy, London, England.—1,655,870.

Process for the Manufacture of Ketones. Louis Lefranc, Paris, France.—1,656,488.

Manufacture of Useful Products by Means of Friedel and Crafts Reaction. Herbert G. Stone and Bernard H. Jacobson, Charleston, W. Va., assignors to E. C. Klipstein & Sons Company, New York, N. Y.—1,656,575.

Gas Furnace. Edwin A. Jones, Milwaukee, Wis., assignor to L. J. Mueller Furnace Company, Milwaukee, Wis., a Corporation of Wisconsin.—1,657,125.

Lithopone and Process of Making Same. James Eliot Booge, Wilmington, Del., assignor to E. I. du Pont de Nemours & Company, Wilmington, Del.—1,657,195.

Inorganic Processes

Dehydrating Ammonia Vapors. Charles Cooper and Daniel Mayon Henshaw, Huddersfield, England, assignors to W. C. Holmes and Company, Limited, Huddersfield, England.—1,654,863.

Deflocculation of Colloids. Walter O. Borcherdt, Austinville, Va., assignor to The New Jersey Zinc Company, New York, N. Y.—1,655,045.

Liquid and Gas Contact Apparatus. Frederick H. Wagner, Baltimore, Md., assignor to The Bartlett Hayward Company, Baltimore, Md.—1,655,171.

Method of Producing White Lead. Chester H. Braselton, Toledo, Ohio.—1,655,723.

Preparation of Metals for Chemical Uses. Charles A. Kraus and Conral C. Callis, Worcester, Mass., assignors to Standard Development Company.—1,655,908.

Novel Composition of Matter. Myron E. Delaney, New York, N. Y., and Linwood T. Richardson, New Brunswick, N. J., assignors to The Cutler-Hammer Mfg. Co., Milwaukee, Wis.—1,655,942.

Process of Making Briquettes Containing Phosphate Rock. James A. Barr, Mountpleasant, Tenn., assignor to The International Agricultural Corporation, New York, N. Y.—1,655,981.

Method of Treating Sulphur. James W. Schwab, Gulf, Tex., assignor to Texas Gulf Sulphur Company, Bay City, Tex.—1,656,504.

Recovery of Sulphur from Ammonium Polysulphide. Paul Koppe, Neurossen, Germany, assignor to I. G. Farbenindustrie Aktiengesellschaft, Frankfort-on-the-Main, Germany.—1,656,563.

Process of Making Beryllium and Aluminum Oxides. Charles F. Brush, Jr., Cleveland, Ohio, assignor to The Brush Laboratories Company, Cleveland, Ohio.—1,656,660.

Method for the Separation of Chlorides of Aluminum and Potassium Present in Mixed Solutions Obtained in the Treatment of Leucite. Gian Alberto Blanc, Rome, Italy.—1,656,769.

Colloidal Copper Sulphide and Process of Preparing the Same. Augustus E. Craver, New York, N. Y., assignor to The Grasselli Chemical Company, Cleveland, Ohio.—1,657,430.

Chemical Engineering Equipment and Processes

Control Valve. Joy S. Reynolds, San Francisco, Calif., assignor, by direct and mesne assignments, of one-half to Joy S. Reynolds, Detroit, Mich., and one-half to Charles A. Balcolm, San Francisco, Calif. —1,654,602.

Process of Separating Vegetable Fibrous Material. Sidney D. Wells, Quincy, Ill.—1,654,624.

Acetylene-Gas Generator. Charles R. Beaty, Frank E. Beaty, and James M. Beaty, Science Hill, and John W. Beaty, Elgin, Ky.—1,654,674.

Process of Reactivation of Adsorptive Material. Walter S. Baylis, Los Angeles, Calif., assignor to Filtrol Company, Los Angeles, Calif.—1,654,629.

Material Separator. Sylvester S. Howell, Chicago, Ill.—1,654,811.

High-Pressure Heating. William O. Durbin, Kenmore, N. Y., assignor to National Aniline & Chemical Co., Inc., New York, N. Y.—1,654,967.

Apparatus for Treating Water for Boiler, Feed and other Purposes. Joseph D. Yoder, Philadelphia, Pa., assignor to Cochrane Corporation, Philadelphia, Pa.—1,655,033.

Apparatus for Separating Liquids of Different Gravity. Wilhelm Linnmann, Jr., Essen-Altenessen, Germany.—1,655,191.

Heating and Agitating Apparatus. Herman B. Kipper, Muskegon, Mich.—1,655,424.

Centrifugal Machine. William C. Laughlin, Glendale, Calif., assignor to Laughlin Filter Corporation, New York, N. Y.—1,655,426.

Classifier. Albert H. Stebbins, Los Angeles, Calif.—1,655,577.

Manufacture of Cellulose Compounds. Frederick Carl Niederhauser and Hayden Benjamin Kline, Cleveland, Ohio. —1,655,626.

Briquette and Method of Manufacture. Lemuel M. Johnston and James L. Farrell, Parco, Wyo.—1,655,728.

Centrifugal Machine. Marcos Larralde Sansaricq, Habana, Cuba.—1,655,774.

Centrifugal Liquid Atomizer. Ferdinand Wreesmann, Munich, Germany.—1,655,932.

Counter Flow Still. Forrest E. Gilmore, Los Angeles, Calif.—1,655,998.

Method of Making and Spinning Derivatives of Cellulose and Formic Acid. Jan Gerard Jurling, The Hague, Netherlands, assignor to Fabriek van Chemische Producten, Schiedam, Netherlands.—1,656,119.

Method for Forming Reconstructed Carbonaceous Fuel. Watson B. Rulon, Philadelphia, Pa.—1,656,364.

Liquid and Gas Contact Apparatus. William Joseph McGurty, Baltimore, Md., assignor to The Bartlett Hayward Company, Baltimore, Md.—1,656,591.

Method of Distilling Coal. Bernhard Zwillinger, deceased, by Klara Zwillinger, administratrix, New York, N. Y., assignor, by mesne assignments, to Tar & Petroleum Process Company, Chicago, Ill.—1,656,617.

Heat-Exchange Apparatus. Gustaf Olof Wolfgang Heijkenskjöld, Lidingo-Brevik, Sweden.—1,656,790.

Wood-Preserving Composition. Karl Heinrich Wolman, Berlin-Grunewald, Germany.—1,656,804.

Process and Apparatus for Liquid Purification of Fuel Gases. Frederick W. Sperr, Jr., and David L. Jacobson, Pittsburgh, Pa., assignors to The Koppers Company, Pittsburgh, Pa.—1,656,881.

Method of Making Producer Gas. Walter M. Cross, Kansas City, Mo.—1,657,371.

Process of Hydrolysis, Particularly the Splitting of Oils and Fats. Percival John Fryer, Kent, England, assignor to Catalpo Limited, London, England.—1,657,440.

Process for Preventing the Formation of Incrustation or Scale in Boilers Caused by Salts of Silicic Acid. Julius Ostertag, Stuttgart, Germany.—1,657,443.

NEWS of the Industry

Committees Named to Direct Petroleum Research

FOLLOWING recommendations made at the annual meeting of the American Petroleum Institute held in Chicago, last December, the president of the institute has announced the appointment of committees on refinery technology, on fundamental research, and on corrosion. E. W. Isom, Sinclair Refining Company will serve as chairman of the committee on refinery technology, with N. E. Loomis, Standard Oil Company of N. J., vice-chairman, and R. P. Anderson, American Petroleum Institute, secretary.

Other members include D. T. Brandt, Henry L. Doherty Co.; C. B. Buerger, Gulf Refining Co.; H. W. Camp, Empire Refineries, Inc.; S. P. Coleman, Humble Oil & Refining Co.; O. P. Cottrell, Associated Oil Co.; T. G. Delbridge, The Atlantic Refining Co.; S. H. Diggs, Mid-West Refining Co.; R. A. Halloran, Standard Oil Co. of Calif.; E. T. Hanlon, Chestnut & Smith Corp.; Frank Holstein, Barnsdall Refining Co.; E. R. Lederer, Texas-Pacific Coal & Oil Co.; K. G. Mackenzie, The Texas Co.; W. D. Mason, Sun Oil Co.; R. R. Matthews, Roxana Petroleum Corp.; Walter Miller, Marland Refining Co.; G. G. Oberfell, Phillips Petroleum Co.; R. C. Osterstrom, Pure Oil Co.; L. W. Parsons, Tide Water Oil Co.; D. Pyzel, Shell Co. of Calif.; F. A. Pielsticker, Skelly Oil Co.; J. B. Rather, Standard Oil Co. of N. Y.; W. F. Sims, Panhandle Refining Co.; W. L. Stewart, Jr., Union Oil Co. of Calif.; L. B. Van Leuven, Vacuum Oil Co.; R. E. Wilson, Standard Oil Co. (Indiana); W. S. Zehrung, The Pennzoil Co.

THE committee on fundamental research will have Dr. R. P. Anderson as chairman. He will be assisted by C. B. Buerger, Gulf Refining Co.; W. F. Faragher, Universal Oil Products Co.; R. A. Halloran, Standard Oil Co. of Calif.; J. B. Hill, The Atlantic Refining Co.; E. W. Isom, Sinclair Refining Co.; C. O. Johns, Standard Oil Development Co.; K. G. Mackenzie, The Texas Co.; R. C. McCollom, 452-3 Roosevelt Bldg.; A. W. McCoy, Marland Oil Co. of Colorado; R. C. Osterstrom, The Pure Oil Co.; L. W. Parsons, Tide Water Oil Co.; A. E. Pew, Jr., Sun Oil Co.; W. A. Raine, Union Oil Co. of Calif.; J. B. Rather, Standard Oil Co. of N. Y.; C. W. Washburne, 27 William St.; R. B. Whitehead, The Atlantic Refining Co.; R. E. Wilson, Standard Oil Co. (Indiana.)

Dr. Anderson also will head the committee on corrosion with F. N. Speller, National Tube Company, as vice-chairman, and D. V. Stroop, American Petroleum Institute, as secretary. This committee also will include P. R. Applegate, Northern Pipe Line Group; E. P. Bly, Standard Oil Co. of Calif.; E. S. Dixon, The Texas Co.; Stanley Gill, Gulf Production Co.; A. E. Harnsberger, Pure Oil Co.; W. P. Haseman, Marland Refining Co.; W. G. Heltzel, Sinclair Oil & Gas Co.; H. F. Perkins, Gulf Refining Co.; Ralph J. Reed, Union Oil Co. of Calif.; Walter Samans, The Atlantic Refining Co.; L. A. Turnbull, Sun Oil Co.; J. C. Walker, The Empire Companies; C. R. Weidner, Prairie Pipe Line Co.; H. W. Young, Midwest Refining Co.

Memorial To Engineers at Louvain Library

THE NEW Louvain library, destroyed by the Germans during the world war, and restored by American benefactions, will be dedicated on July 4, according to a statement by the Engineering Foundation.

The Foundation is arranging for the presence of a delegation of American engineers at the dedicatory ceremonies. Under the auspices of the Foundation, a clock and carillon will be placed in the tower of the new library building at a cost of $80,000, to be subscribed by members of the engineering profession in this country.

The clock and carillon, the gift of 56,000 American engineers, will be installed "in memory of the engineers of the United States of America who gave their lives in the service of their country and its allies in the Great War 1914-1918." There will be forty-eight stars in the four dials of the clock on the tower of Louvain Library and forty-eight bells in the carillon. This number was selected so every state in the Union might be represented.

Dr. Adams will head the engineering contingent at Louvain. Arrangements are being made for members of the committee, representatives of the societies participating in the Engineers Memorial, members of their families and friends who wish to attend the dedicatory services in a party.

Austrian Interests and I. G. in Sales Agreement

IN A report from Berlin, trade commissioner W. T. Daugherty states that the I. G. Farbenindustrie and several Austrian chemical producing establishments have concluded a sales agreement covering a range of heavy chemicals including, alum, ammonia, sodium thiosulphate, chrome alum, sulphur chloride, Glauber salts, potassium nitrate, sulphurous and hyposulphurous soda, ammonia salts, sodium sulphide, etc. The agreements, according to the local press, reserved to Austria sales of certain heavy chemicals in the nearby markets such as Turkey, Hungary, Jugo-Slavia, Rumania and Bulgaria while the I. G. covers Czechoslovakia, Poland and Western states. Nitrogenous fertilizers are probably not included in the agreement. Austrian producers reached agreements with the important chemical industries of Hungary and Czechoslovakia during 1927 and it is assumed that the German I. G. may also enter price convention involving export market divisions with these two Central European States.

University of Michigan Offers Fellowships

THERE will be at least six industrial fellowships of $750 each available in the Department of Chemical Engineering at the University of Michigan next college year. The facilities of the department and the attainments of its personnel are described in a pamphlet just published by the university as Official Publication Vol. 29, No. 10. Applications for the above fellowships should be made by April 1. Additional information may be obtained by addressing the Department of Chemical Engineering, University of Michigan, Ann Arbor, Mich.

Northwestern University also announces opportunities in its Department of Chemistry for graduate assistants, research fellows and university fellows. Applications for graduate appointments should be sent to Frank C. Whitmore, National Research Council, Washington, D. C., before Mar. 1, 1928. Before that date, each applicant should send an official transcript of his academic work and a recent photograph directly to the Chemistry Department, Northwestern University, Evanston, Ill.

Perkin Medal Awarded To Dr. Langmuir

DR. IRVING LANGMUIR of the research laboratory of the General Electric Company, and outstanding research chemist and physicist was awarded the Perkin medal for 1928 at a notable meeting held at the Chemists' Club in New York on January 13. This award, made annually by the American section of the Society of Chemical Industry in collaboration with the three other major chemical societies, was in recognition of Dr. Langmuir's contributions to American chemical industry, among them the invention and development of the atomic hydrogen welding process. In connection with his fundamental studies of chemical gas reactions, particularly those of dissociated hydrogen, the medalist determined the heat of association of hydrogen atoms. Finding this very large, he produced a new kind of electric arc welding that has greatly extended the field of electric welding. Perfect joints between even such refractory metals as molybdenum and chromium can now be made as this new fundamental knowledge is being rapidly applied in industry.

The occasion of the medal presentation was an auspicious one. There were many distinguished chemists and industrialists in the gathering. Dr. Ellwood Hendrick, in characteristic and happy mood, reviewed the early life of the medalist, showing how the faculties of insatiable curiosity and insistent application were developed during the formative period of his career. Then Dr. Willis R. Whitney spoke of Dr. Langmuir's scientific achievements as a member of the research staff of the General Electric Company. He referred to work in such widely different fields as "chemical reactions at low pressure, conduction, connection and radiation of heat, vapor pressures of metals, new vacuum pumps and vacuum gages, crystal structure, atomic structure, electronic and ionic currents, high-power vacuum tubes, theories of absorption, of evaporation, of passivity, etc." In all of these subjects, according to Dr. Whitney, the medalist has combined rare insight with unusual practical experience.

As indicative of the monetary value of just one of these achievements, the speaker pointed out that Dr. Langmuir was the first to apply argon and nitrogen to the tungsten lamp, "thus reducing by 50 per cent the cost of most of the light we buy." One way to express the value of this improvement of putting gases into the tungsten lamp is to say that it saves the American public more than a million dollars a night on its lighting bill of over a billion dollars a year.

Dr. Whitney discussed in detail the development of the atomic hydrogen welding torch, showing that it resulted from fundamental investigation prosecuted some 15 years before its broad commercial application. This is typical of other long series of researches made by the medalist. "His production," said Dr. Whitney, "is not sporadic, sudden and accidental but has an almost predictable certainty about it."

The actual presentation was made by Dr. William H. Nichols, former president of the Society, who recalled that this was not the first time he had been called upon to do honor to the medalist. Dr. Langmuir was twice awarded the Nichols medal, once for work on chemical reactions at low pressure and again for work on atomic structures. The Hughes medal came to him for researches on molecular physics, and the Rumford medal for thermionic researches and for the development of the gas-filled lamp.

DR. IRVING LANGMUIR
PERKIN MEDALIST FOR 1928

Numerous Conferences for Institute of Chemistry

FOLLOWING is a tentative list of subjects for conferences for the A.C.S. Institute of Chemistry which will be held in Evanston, Illinois, from July 23 to August 18, 1928. Suggestions and criticisms should be sent to F. C. Whitmore, National Research Council, Washington, D. C. There will be twenty-eight conferences, arranged at time when two and a half hours will be available for each. Thus, several conferences can be devoted to the same subject if it seems important enough to warrant this.

One group of subjects will deal with the help which chemistry can give for the better utilization of raw materials: agricultural products, coal, petroleum, metals, animal products.

Obviously, only certain aspects of these subjects can be covered. In addition, certain miscellaneous subjects have been suggested for conferences: chemotherapy, disposal of municipal wastes, rubber, science and national defense, chemistry life processes, synthetic "raw" materials, antioxidants, cellulose.

Suggestions are needed regarding the special phases of these topics which can best be treated and regarding the best men to lead the discussions.

Four Engineering Companies in Merger

THE MERGER, under the name of United Engineers and Constructors, Incorporated, of four important engineering and contracting organizations was announced on Tuesday January 17, 1928. The companies involved are: Dwight P. Robinson & Company, Inc., New York; U. G. I. Contracting Company, Philadelphia; Public Service Production Company, Newark, N. J.; and Day & Zimmermann Engineering & Construction Company, Philadelphia. The new company is launched with contracts in hand amounting to more than $100,000,000.

Dwight P. Robinson has been selected president of the new company. Directors include Mr. Robinson, Arthur W. Thompson, president, United Gas Improvement Company, who is chairman of the board of the new company; Thomas N. McCarter, president, Public Service Corporation of New Jersey; Samuel T. Bodine, chairman of board of directors, United Gas Improvement Company; Paul Thompson, a vice-president of the United Gas Improvement Company and president of the Philadelphia Gas Works Company; and John E. Zimmermann; president of Day & Zimmermann, Inc.

Details of the financial features of the plan under which the combination was effected have not been made public but it is understood that an exchange of stock similar to the proceeding in the acquisition of Day and Zimmermann, Inc., by United Gas Improvement Company is involved. Headquarters will be in Philadelphia but local representation in New York, Newark, N. J., Chicago, Los Angeles, Atlanta, Houston, Pittsburgh, Buenos Aires, and Rio de Janeiro will be maintained.

Bill Introduced to Prevent Adulteration of Paint

A BILL for preventing the manufacture, sale, or transportation of adulterated or mislabeled linseed oil, turpentine, or paint, has been introduced by Senator Reed of Pennsylvania. To carry out the act provision is made for the collection and examination of these products as they are sold in interstate commerce. The examination is to be supervised by the Secretaries of the Treasury, Commerce, and Agriculture, aided by the Bureau of Chemistry of the Department of Agriculture.

A fine of $200 would be imposed for the violation of this act and the general enforcement is charged to the Federal judiciary. Exception is made in the case of paint, turpentine, or linseed oil manufactured under a contract for particular use or for exportation to foreign countries. In explaining the term mislabeled it is stated that such classification extends to goods that are an imitation, to cases where other contents have been put into the original package, and in cases where the package bears untrue statements.

NEWS FROM WASHINGTON

By Paul Wooton

Washington Correspondent of Chem. & Met.

AFTER SEVERAL postponements the yachting trip, during which an international nitrogen entente is to be discussed, is now set for a date early in April. During a cruise of the Mediterranean it is hoped that a plan may be evolved which will eliminate some of the uncertainties being faced by the nitrogen producers. No information has reached this country as to whether or not a representative of the Chilean producers has been invited to be present, but it is expected that no such invitation will be extended. It is understood that an American observer will accompany the party. Individual American producers would be precluded from joining by our anti-trust statutes, but an export corporation could co-operate with an organization of foreign producers.

So far as can be learned the objectives of the proposed entente are commendable. One purpose is to devise means of stimulating the use of nitrogen. The fixed nitrogen producers foresee the time when their output will be in excess of requirements unless prompt steps are taken to stimulate the demand. Doubtless an effort also will be made to work out a plan for the restriction of production if the effort to increase the use should fail to provide sufficient market.

IN THE consideration of increased uses principal attention will be given the prospects of marketing more concentrated fertilizer in Europe. The success which has followed such an effort in Germany holds out the possibility that it can be extended to other countries. The need for better fertilization is a crying one in many parts of Europe. In addition, consideration probably will be given means for stimulating the consumption of rayon, lacquers, celluloid and other products using nitrocellulose. Increased use of ammonia as a solvent also will be considered, it is believed.

An example of the effect of a single new use is had in the increased demand for celluloid growing out of the commercial use of non-shatterable glass. In addition, the idea of putting a film of celluloid between sheets of glass now bids fair to expand into the fields of glass manufacture where color or other properties may be introduced with the celluloid sheet.

The British-German chemical agreement is making no progress, according to information reaching Washington. At the same time, the idea of an agreement within the Empire is gaining ground. Instead of facing competition from a single cartel that would include all of Europe, American chemical manufacturers may have to deal with two cartels, one dominated by the Germans and another by the British. The advocates of the new plan being put forward in Great Britain point to the success of the American industry based on its domestic market. If the British commonwealths will co-operate, an organization can be built up within the Empire based on domestic business which then could become a formidable competitor of the German-French cartel and of the American industry as well.

ACCEPTANCES have been received from prominent members of the chemical industry, to an invitation extended by Secretary Hoover, to attend the second meeting of executives of the chemical industry to be held at Washington on February 16. The meeting will be under the auspices of the Department of Commerce. The meeting will open at 10 o'clock on the morning of February 16, with A. Cressy Morrison presiding. Addresses will be delivered by department heads of the Department of Commerce. C. C. Concannon, chief of the Chemical Division will speak on "The Chemical Industry." Dr. Julius Klein, director of the Bureau of Foreign and Domestic Commerce will discuss "The Department of Commerce and the World Economic Situation." Ray M. Hudson, assistant director, Bureau of Standards will follow with a discussion on "The Significance and Application of Simplification in Industry." The morning session will close with a paper by T. W. Delehanty, assistant chief, Chemical Division, on "Opportunities in Export Trade."

The afternoon session will be called at 2 p.m. and will open with an address on "Foreign Cartels and American Industry" by Col. W. J. Donovan, assistant to the U. S. Attorney General. Wm. T. Daugherty, trade commissioner at Berlin will follow with an exposition on "The German Chemical Industry." "The French Chemical Industry" will then be discussed by D. J. Reagan, assistant commercial attaché at Paris.

The remainder of the afternoon will be devoted to an open forum with department experts on hand to answer questions pertaining to such subjects as advertising, collections, credit ratings, distribution surveys, foreign loans, foreign tariffs, packing, synthetic rubber, etc.

A dinner scheduled for the evening has been canceled owing to the inability of Secretary Hoover to attend because he will be away on that day.

Joint research by the Bureau of Mines and the Geological Survey to discover a practical process for the recovery of potash from the leucite deposits of Wyoming, would be authorized under the terms of a bill introduced into Congress by Representative Winter of Wyoming. The text of the measure relates that the Geological Survey has reported the existance of great surface deposits of potash in the leucites of Wyoming.

THE United States Tariff Commission on February 3, completed its hearings on the complaint brought by the Bakelite Corporation of alleged infringement of their patent rights. The complaint stated that certain European chemical manufacturers are selling synthetic resinoid products in this country contrary to the laws of the United States and by methods which are distinctly unfair to American producers. A temporary embargo has been placed upon jewelry and smoking novelties pending decision on appeal by importers from the report of the Tariff Commission after a controversy which has lasted more than two years.

At the hearing representatives of the Bakelite Corporation stated that sales of the imported material were obtained upon samples of domestic bakelite, the importing interests sought to refute such contentions. The defendants denied that they had ever offered the imported product as bakelite, but, on the contrary, had sold "laminate" or laminated sheets by number designation only.

The attorney for the defendants in his argument said that he could not see why the domestic product should be sold at such a high price under the present high speed method, and thought that the price should be around 35c. or 40c. a pound.

He also said that as long as the Bakelite Corporation holds all patent rights on synthetic phenolic resin, and could fix the prices to suit themselves, he could see no reason why the importation of an inferior product which could be used in many of the ways as the domestic material and sell at a cheaper price should be prohibited from entering the country.

A great increase in the interest in solidified carbon dioxide is indicated by inquiries coming to various government bureaus. There is evidence that the commercial use of this product is on the verge of material expansion. That the day will come when it will supplant ice in the refrigeration of freight cars and in the handling of perishable products by other means is predicted.

In an effort to check the recovery of alcohol from tincture of iodine and its diversion into beverage channels, a regulation has been issued by the Prohibition Commissioner requiring orders for iodine, in excess of fifty gallons monthly, to be submitted to the district prohibition administrator. The action was taken after a conference with the manufacturers. Commissioner Doran explains that bootleggers have taken advantage of the ease with which the iodine is precipitated by the use of zinc dust. The zinc iodide is then thrown back on the market to the disadvantage of the trade.

Chemical Trade of Great Britain Shows Expansion

Imperial Chemical Industries Increases Capital in Order to Acquire Metal Companies

From Our London Correspondent

CHEMICAL markets continue to show gradual expansion both for home and export trade, prices remaining without material change. On the other hand, stock values have shared in the upward movements due to recent stock exchange activity in industrials. The general trend of opinion indicated that 1928 is considered to hold out adequate promise of improving trade conditions. The value of chemical engineering is being increasingly recognized, yet only six years ago a leading chemical industrialist stated that his board of directors did not consider special chemical engineering training either desirable or necessary. The present day view was admirably expressed in an article published in the *Times'* special chemical issue of its trade and engineering supplement, and now that the professorship at University College is to have a new occupant, it is refreshing to find the firm in question joining forces with others in providing the necessary funds.

There seems to be nothing of outstanding importance to record in chemical plant design and the trend of progress is mainly limited to the perfecting of materials and their more rational application in relation to corrosion and resistance to working conditions. Acid-resisting nickel chormium steels are being boomed and in many cases with successful prospects. The largest individual pieces now being made are probably railway tank cars intended for instance for the conveyance of nitric acid made by the oxidation of ammonia. Homogeneous lead lining is being increasingly used wherever anything approaching severe conditions is met, the saving in repair bills compensating for the extra cost. The growth of the synthetic hydrochloric acid industry has called for hard rubber lining and for this and similar purposes, soft cold cured rubber linings are also finding adoption.

The two most interesting chemical developments in chemical engineering plant are probably those relating to submerged combustion, and the filtration and separation of oils under the patents of the Stream-Line Filter Co. The Brunler-Hammond patents for submerged combustion have been described fully by Norman Swindin in "World Power" and in the Society of Chemical Industry's Journal. The somewhat exaggerated possibilities claimed for this method have been reduced and it seems likely that they will find extended application particularly in connection with the concentration of acid and caustic liquors. The Stream-Line filter is finding extended use for the continuous filtration of lubricating oils in Diesel engines and for filtration of oils and other substances containing very fine suspensions. In a paper recently read before the Society of Chemical Industry at Liverpool, C. S. Garland appears to have furnished the first satisfactory solution of the oil pollution problem of seas and harbors and the apparatus tested by the British Admiralty passed its trials with conspicuous success at a capacity of 200-300 tons per hour with water containing an average of about 10 per cent of navy fuel oil. The permissible content of the water after filtration was one part of oil in 200,000 of water and it is understood that a similar plant for the Japanese government has just been successfully tested. It would seem that the principle employed is capable of adaptation in other directions and the invention is an excellent example of the patient development of a practical plant based on sound first principles.

IT IS obviously inevitable that these notes should record regularly news and developments relating to Imperial Chemical Industries or "I.C.I." and to those interested in dyestuffs the abbreviation brings to mind the coincidence that the British Dyestuffs Corporation markets icyl colors. Recent rumors relating to impending absorption of other concerns have not been justified by events, to the disappointment of certain companies that have been tentatively sitting on the fence. Powers have been taken for the issue of additional capital and apart from the acquisition of Elliots Metal Co. and allied concerns needed for the consolidation with Kynochs of the copper branch of I.C.I. activities, no use has yet been made of them. The synthetic ammonia and kindred plant at Billingham are, however, expanding rapidly and this is strikingly illustrated by two photographs in the I.C.I. magazine, the first issue of which recently appeared. This is a monthly booklet of more than one hundred pages in excellent paper and print, which is sold at 4c. to a probable circulation of over 50,000, and the firrst issue appears to have been oversubscribed.

A miniature bombshell was thrown into the rayon industry in January by British Celanese Ltd. in the form of a statement that it would be impossible for rival concerns to manufacture cellulose acetate yarns, fabrics or other textile articles of commercial value without infringing at some stage some of the company's patent rights. A counter attack from the Non-Inflammable Film Company developed immediately by way of a refutation of the Celanese viewpoint by three eminent patent counsel. The bomb appears likely to have a faulty or, at any rate, delayed-action fuse and the general view is that the Celanese Company will be well advised not to devote time and money to litigation at the expense of the dividends which are in process of being earned.

It is understood that Bertrand R. Clarke, president of the Industrial Rayon Corporation of America, will be intimately connected with the new company and that manufacture will not be confined to the production of silk. The prospectus is likely to appear at the end of this week and a factory is to be acquired in the Manchester district. Other acetate companies, such as the Apex, appear to have met with manufacturing difficulties, which have recently been overcome and the acetate silk market should therefore present many interesting features during the coming year.

In the metallurgical field, there has been something of a mild sensation arising out of the publication on January 19 of a paper read before the Institution of Mining & Metallurgy on the extraction of zinc and other metals from ores. The process is that of H. Edwin Coley, who has been working for about five years on the use for the reduction of ores, of nascent carbon obtained by cracking paraffin. There is nothing new in the idea of using hydrocarbons for the reduction of ores, but very little seems to have been known about the basic principles underlying the reduction. In any case the mechanical difficulties of a rotary furnace working at 1,100 deg. Centigrade, which has to be kept gastight and the expansion of which has to be allowed for, were such that previous investigators regarded the problem as hopeless.

Coal-Tar Firm Not Liable for Richelieu Explosion

A DECISION of importance to the coal-tar industry was rendered, Jan. 28, in the U. S. District Court for Maryland, in the case of the barque Richelieu which was destroyed Jan. 4, apparently by an explosion of briquette pitch dust in which seven lives were lost.

The F. J. Lewis Manufacturing Company was brought into the lawsuit which ensued and was charged with contracting to have the pitch loaded by use of coal-loading trimmers and with not making known to the railroad that pitch is a dangerous commodity. A decision to dismiss the libel against the Lewis company was rendered at the close of the railroad's case without requiring the defendant to put in evidence.

Wide interest in the case lies in the testimony of experts that pitch dust is apt to cause disastrous explosions when brought in contact with open flame torches or exposed electrical contacts. In the latter case the pitch dust congeals under slight heat, setting up a resistance between the exposed electrical contacts and resulting in combustion.

Distillation of Coal Stimulates Research Work in France

Numerous Companies Lay Claim to Successful Efforts in Search for Mineral Oil Substitutes

From Our Paris Correspondent

NEW COMPANIES are springing up almost daily which promise to furnish supplies to make the country independent of petroleum. While many of these concerns are genuine, the majority make claims which are based on incomplete knowledge. Low temperature distillation of coal seems to have a capable exponent in the case of the Société Des Carburants Et Produits De Synthèse. This company is backed by collieries, almost every French mine owner being a stockholder and the total coal output so represented amounts to 37,000,000 tons.

The Mines of Béthune still manufacture ethyl and methyl alcohol in spite of the contradictory information given by the daily press. These alcohols are manufactured industrially for the State which has bought the distillation factories. A similar distillation factory has been equipped at the Mines de Lens for the manufacturing of methyl alcohol.

On the other hand the Kuhlmann works, which have increased their capital to 250 million francs, have decided to build in partnership with the Mines de Courrières, works for the manufacture of methanol from gas of the coke-ovens of this mining company. It is expected that this factory will be in operation in 1928.

AMONG the leading industrial developments is the final agreement made between the I.G. and the French group of coloring matters works. According to certain rumors the agreement was no easy one. The French works' aim was the maintenance of their present situation on the foreign markets. It seems they have been given entire satisfaction on this point. To have an idea of the difficulties overcome it should be remembered that since the war all the great manufacturing countries had made all necessary arrangements to have an independent organic chemical industry giving to all these new industries a distinctly national character on account of its importance from national home defense standpoint. This was particularly true for France and Great Britain.

Though all these chemical industries have since been released from the State's dependence, they all kept from their common origin a distinctly national stamp and one of the most arduous moral obstacles to overcome was to have the majority of chemical manufactories admit the necessity of an entente with the ex-enemy manufacturers.

If the entente between the French group and the I.G. is, according to reliable information, based on the manufacturing of coloring matters, attention should be drawn to the big effort made by the Germans since the war, not only on dyestuffs but especially on fertilizers. German coloring matters, especially those needing a long and careful manufacture, still maintain their superiority but the ordinary German dyestuffs are gradually losing this superiority.

It should be said, however, that the Germans have improved their manufacturing processes; thanks to the composition of their groupments, they have standardized their manufactured products to such an extent that they have perceptibly lowered their cost prices. They have also made great improvements by reducing notably the number of coloring matters which they manufactured formerly and which reached the high figure of 8,000. In spite of this the I.G. only does 50 per cent of the world coloring matters against 88 per cent in 1913. The I.G. thought, however, that a commercial entente including the exchange of technical experiments and patents would be profitable to compete united on the world market against American competition. However, the entente is fundamentally more of a defensive than agressive character against the United States which has become a formidable competitor. According to information received, combined work will be done by both contractants of this entente. The foreseen rationalizing and cutting down of manufacturing expenses of all contractants will also draw another mutual entente for the buying and stocking of raw material at lowest price. These agreements are particularly interesting for the manufacturing of fertilizing matters particularly those starting from phosphates. In this branch it seems the collaboration of the I.G. and Kuhlmann group would give excellent results especially for the manufacturing of combined fertilizers which the Germans have thoroughly investigated. Moreover there is no single chemical branch where the Kuhlmann group and the I.G.'s interests are not interwoven.

MUCH has been written about the governmental Toulouse powder works where nitrogen is being manufactured. When asked to vote for the necessary credits for this concern the Chamber of Deputies came to the conclusion that the works had been utterly mismanaged. Originally the Toulouse powder works were to manufacture nitrogen according to the Haber-Bosch process yielded to France by the Treaty of Versailles. Twelve engineers had even been sent to the Ludwigshafen works to thoroughly investigate the process. When in 1925 everything was ready to start manufacturing, the trustees' committee decided to manufacture nitrogen according to the new Patart process.

As, according to information given, this new patent was both complicated and incomplete, it did not give the expected results and another process was acquired—the Damiens process. An extensive and expansive rebuilding of the works had to be gone through. When the new works were ready, a very serious error in the rebuilding was veried which prevented all further manufacturing.

Automatic Foam Generation in Fire Extinguisher

AN EFFECTIVE demonstration of a newly developed automatically operating fire extinguisher, using a foam blanket laid down from permanently installed sprinkler heads, was demonstrated on Jan. 19, at the plant of the Pyrene Manufacturing Company in Newark, N. J. Three typical industrial fire hazards were simulated; a circular tank 30 feet in diameter filled with oil and gasoline, a pair of lacquer spray booths and a varnish dipping tank with drain board. In each case the foam blanket effectively smothered the fire.

The novel feature of the Phomene Accumulator System, as it is called, is the apparatus which automatically begins to generate foam as soon as the temperature at the hazard reaches a certain maximum. A large tank filled with foam producing powder is connected with the plant water main through an automatic valve which is opened either by the breaking of the ordinary water sprinkler head or by means of air pressure transmitted back from the hazard by the expansion of the air in a small copper tube coil at the hazard. As soon as the water is admitted to the accumulator, the foam is forced through a separate pipe line to sprinkler or spreader heads to the fire.

The Phomene Accumulator System is the result of the combined efforts and experience of the Pyrene Manufacturing Company, the Globe Automatic Sprinkler Company of Philadelphia and the Minimax Company which is located in Germany.

Chemical Pulp Production Increases in Germany

PRODUCTION of chemical pulp in Germany has increased about 15 per cent over pre-war records, and 1927 production will in all probability represent an increase of 20 per cent, according to a recent report to the Department of Commerce. About 15 per cent of the output is exported. The increase in the manufacture of this class of pulp is attributed chiefly to the rise of the rayon industry. The output in all pulp producing countries, however, has more than kept pace with the increased consumption with the result that world prices have shown a downward trend.

News in Brief

CONCURRING with the decision of the Association of Official Agricultural Chemists to change the term "acid phosphate" to the original term "superphosphate," Secretary of Agriculture Jardine has announced that all reference to this material in department publications and correspondence will hereafter be made through use of the term "superphosphate," with the old name carried in parentheses until the change is established.

THE APPOINTMENT of James E. Wallis, Jr., of East Aurora, N. Y., as Trade Commissioner at Berlin was announced February 4, by Dr. Julius Klein, Director, Bureau of Foreign and Domestic Commerce. Mr. Wallis will succeed Theodore Pilger of Loup City, Nebraska, who is now in Washington.

PROVISION is being made in the Canadian Government estimates for an initial appropriation for the erection of one institution in Ottawa, of a series of laboratories to promote scientific and industrial research. The government has long been anxious to proceed with a national research bureau and action was taken after the provincial representatives at the Dominion-Provincial conference last year expressed themselves very much in favor of a federal research laboratory. A modest beginning will be made this year. A site will be secured and plans will be drawn, but the larger construction will be deferred till 1929.

OPERATORS of the Greater Seminole oil field of Oklahoma have agreed to extend the present shut-down rulings in that area until April 1. The Little River Pool curtailment agreement was excepted from this decision and the curtailment program there will terminate March 1.

THE HERCULES POWDER COMPANY announces the development of a new lacquer ingredient, Ethyl Abietate, which has been referred to as a plasticizing resin. Preliminary investigation work, covering a period of several years, has indicated that this material offers attractive possibilities in lacquer manufacture.

INVESTIGATION of alleged violations of the anti-trust laws by fertilizer corporations is provided for in two resolutions introduced in the House January 20 by Representative Larson, of Dublin, Ga.

THE POLYTECHNIC INSTITUTE of Brooklyn has announced a raising in the standards of its engineering degrees. Here after, the successful completion of the prescribed four-year course in civil, mechanical and electrical engineering and the five-year curriculum in chemical engineering will qualify candidates for the degree of Bachelor of Engineering, rather than the degree of Engineer, as heretofore. A year of engineering experience and the completion of 12 hours of graduate work will be required of candidates for the degree of Engineer. As an alternative, candidates for the degree of Engineer may submit three years of experience and a suitable thesis.

Parsons Awarded Medal by Harmon Foundation

JAMES A. PARSONS, JR., who is in charge of the chemical and metallurgical laboratory of The Duriron Company, is a member of the negro race and has just been given the first award

JAMES A. PARSONS, JR.

in science of the Harmon Foundation, consisting of a gold medal as well as a substantial cash prize.

Mr. Parsons graduated in electrical engineering from Rensselaer and entered the employ of The Duriron Company in 1922 as a routine, analytical chemist. His originality and technical knowledge became so evident that he was rapidly entrusted with greater responsibilities and he is now in complete charge of research and development work as well as analytical laboratory and metallurgical control. Mr. Parsons has under him six chemists—all of his own race.

New Fuel From Chemical Pulp Refuse

A REPORT from Sweden states that a Swedish engineer is reported to have solved the problem of using excess sulphite lye and lumber refuse obtained in the manufacturre of chemical pulp by the invention of a method of producing a first class fuel. The sulphite lye has hitherto been used as a tanning extract, a binder for brick-making, in agriculture, a means of road conservation and a fuel for internal combustion engines, as well as for the production of alcohol and fuel briquets. The amounts used for these several purposes have, however, been relatively insignificant, and the majority of the pulp-makers disposed of the lye as waste. The most important point in the new invention is an improved method of distilling the lye, which makes the resulting substance easily absorbable in sawdust and wood shavings.

T.A.P.P.I. Completes Plans for Annual Meeting

PULP AND paper week in New York City begins on February 20, with the Waldorf-Astoria Hotel as usual, the center of activity. The Technical Association looks forward to an exceptionally well attended and worth-while program, from the time its executive committee meets at the Canadian Club at noon on Monday, Feb. 20, until the final sessions which is scheduled for Thursday afternoon.

Dr. Ernst Laher, vice-president of the Kimberly-Clark Company, and one of the founders of T.A.P.P.I., will present an important paper at the session of the American Pulp and Paper Association on Tuesday, on "Technical Control in the Pulp and Paper Industry."

The formal sessions of the Technical Association will begin Wednesday morning with the usual reports of committees. The high spot of the meeting will be an address by George W. Scott, of the Mechanical Department of McGill University on "The Structure of Wood and Its Permeability." The afternoon will be devoted to three sectional meetings: "Heat, Light and Power," presided over by E. F. Troop of P. H. Glatfelter Company, Spring Grove, Pa.; "Paper Testing," with B. W. Scribner of the Bureau of Standards as chairman, and "Cellulose," presided over by W. E. B. Baker, chief chemist of the Continental Paper and Bag Mills Corporation.

Speakers at the thirteenth annual dinner of T.A.P.P.I., which will be held at the Hotel Commodore on the evening of Feb. 22, will include E. R. Weidlein, Director of the Mellon Institute and Hollis Godfrey, President of the Engineering Economics Foundation.

Three sectional meetings will feature Thursday's program. The discussions of stock preparation, under the chairmanship of G. K. Spence of the New York Pennsylvania Company, will be featured by a paper on "Hydrogen Ion Measurements in the Pulp and Paper Mill" by W. F. Hoffman of the Northwest Paper Company, of Cloquet, Minn. The sectional meeting on mechanical pulp will be presided over by S. C. Brayton of the Itasca Paper Co., and the group on "training for the industry" by Allen Abrams, of the Marathon Paper Mills.

New Byproduct Coke Ovens in Russia

The Garlovka Mining Administration has put into operation 100 coke ovens low temperature distillation type with an annual production of 25,000,000 poods of coke (1 ton equals 62 poods). In order to make use of all waste products from the coking processes, a new chemical plant is being constructed. This plant will produce a wide range of chemicals with benzol and paraffin holding a prominent place.

MEN in Chemical Engineering

Edward Bausch, president of the Bausch & Lomb Optical Company, Rochester, N Y., has been elected an honorary member of the American Microscopical Society, "in recognition of more than 50 years of active interest in microscopy."

Prof. Hugh S. Taylor, head of the Department of Chemistry in Princeton University, has been awarded the Nichols medal for 1928 by the New York Section of the American Chemical Society. The award will be formally conferred in New York City on March 9.

J. Frank Rogers has resigned as manager of the Gas Producer Division of the Wellman-Seaver-Morgan Company, and is being succeeded by Victor Windett of the same division.

William D. Le Bar has been appointed superintendent of the plant of the Pennsylvania Salt Manufacturing Company at Wyandotte, Michigan, to succeed Y. F. Hardcastle, recently elected vice-president.

Gerald Wendt has resigned his position as a dean of Penn State College, effective at the end of the present university year, to become director of the newly founded Battelle Memorial Institute. This Institute was founded by an endowment of several million dollars provided by the will of Mr. Gordon Battelle who, during his life time, was one of the principal owners of the American Rolling Mill Company. Plans for the first two buildings of the Institute, which will be located at Columbus, Ohio, are nearing completion and actual construction will begin this spring. Full determination of the Institute policy has not yet been made, but it is expected that the work will include both fundamental research and some industrial research of the type requiring active participation and co-operation of commercial groups.

J. L. Wiley, formerly librarian and translator for the Solvay Process Company has joined Arthur D. Little, Inc., Cambridge, Mass., in a similar capacity.

Charles H. Bromley has joined the staff of the France Packing Company, Philadelphia, Pa., as vice-president.

Arthur J. Hoskins has joined the chemical engineering staff at Purdue University and will devote his time exclusively to research on the spontaneous ignition of stored coal, with special reference to Indiana coals.

Chester H. Jones, formerly assistant editor of *Chem. & Met.* and later technical director of sales of the Fansteel Products Company, has been transferred to New York City as Eastern district manager. He will make his home in Upper Montclair.

Photo by Blank-Stoller, Inc.
CHESTER H. JONES

Dr. James F. Norris of the Massachusetts Institute of Technology has assumed the consulting editorship of the International Chemical Series. This series, which now comprises upward of 30 titles, was first undertaken in 1910 by the McGraw-Hill Book Company, under the consulting editorship of the late Dr. H. P. Talbot of the Massachusetts Institute of Technology. The first books published in this series were Dr. Norris' *Principles of Organic Chemistry* and Dr. H. P. Cady's *Inorganic Chemistry*, which came out on October 17, 1912. Dr. Norris had been associated with Dr. Talbot for considerable periods since 1895, when he first joined the Department of Chemistry at the Massachusetts Institute of Technology immediately after receiving his degree at Johns Hopkins University. Dr. Norris was president of the American Chemical Society in 1925 and 1926. He made a notable record in the Chemical Warfare Service during the World War and since then, in many important researches. He brings to the International Chemical Series a rare combination of experience and ability.

Prof. Samuel Wilson Parr, internationally known for his researches in coal chemistry, has been elected president of the American Chemical Society for 1928 to succeed Dr. George D. Rosengarten of Philadelphia. He has been a professor in the University of Illinois since 1891. In his association with the American Chemical Society he had already been a director and a member of the executive committee.

Dr. Bernard Herstein was promoted to the position of chief technologist of the U. S. Industrial Alcohol Company, effective January 1. Born in Galicia in 1866 and educated at the University of Berlin, Germany, he held successive government posts with the Bureau of Chemistry, Washington, and the U. S. Customs in the period from 1909 to 1917, serving finally as Insular Collector of Customs of the Philippine Islands. Dr. Herstein's activities with the U. S. Industrial Alcohol Company date from 1917.

Dr. William J. Hale, director of Organic Research of the Dow Chemical Company and past chairman of the Division of Chemistry and Chemical Technology of the National Research Council, has been appointed chairman of the Division's committee to foster co-operative researches between industries and academic institutions.

T. B. Wagner, consulting chemical engineer, has removed his office from 217 Broadway to 52 Vanderbilt Ave., New York City.

E. A. Cappelen Smith, president of Anglo-Chilean Nitrate Corporation, has left for Chile to inspect operations and push extensions in the producing capacity of the plant there.

Dr. Thomas Stockham Baker, president of the Carnegie Institute of Technology, Pittsburgh, will spend six weeks in Europe during February, March, and April, to organize plans for the Second International Conference on Bituminous Coal to be held at Pittsburgh, in November, 1928.

CALENDAR

American Ceramic Society, tour through France, Germany, Czecho-Slovakia and England, May 19-July 16.

American Chemical Society, spring meeting, St. Louis, April 16-20.

American Electrochemical Society, spring meeting, Bridgeport, Conn., April 26-28.

American Institute of Mining and Metallurgical Engineers, 136th meeting, New York City, February 20-23.

American Society for Steel Treating, annual meeting, Montreal, February 16-17.

Institute of Chemistry of the American Chemical Society, second session, Evanston, Ill., July 23-August 18.

Institute of Metals, twentieth annual general meeting, London, England, March 7-8.

Technical Association of the Paper and Pulp Industry, 13th annual convention, New York City, February 20-23.

JAMES D. TEW has been appointed first vice-president and general sales manager of the B. F. Goodrich Rubber Company of Akron, Ohio. He has been with the company since 1906, and his most recent post was works manager.

C. MARSHALL TAYLOR has been named vice-president and general manager of the Curtin-Howe Corporation, New York City, after being actively engaged in work on wood preservation since 1906.

WILLIAM F. TRAUDT, for eighteen years with the Taber Pump Company, Buffalo, N. Y., has been re-elected president of that organization.

OBITUARY

DANIEL KENNEDY, president of the Kennedy Valve Manufacturing Company, died at Hot Springs, Ark., on January 14 after a brief illness. Mr. Kennedy, who was in his eightieth year, had come to America from Ireland at the age of seventeen. Not many years afterward the construction of the old Boston Dry Dock and a contract for a series of valves gave him the opportunity for establishing the business out of which the Kennedy Valve Manufacturing Company ultimately grew.

THOMAS ARTHUR JONES, vice-president of the W. A. Jones Foundry & Machine Company and president of the Sackett Screen and Chute Company, died at his home in River Forest (Chicago) on January 19.

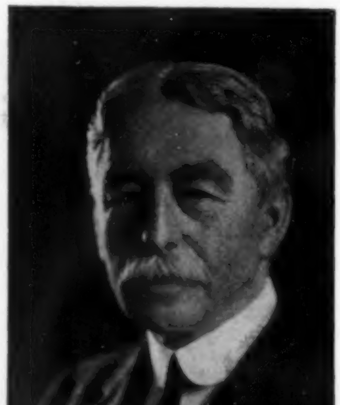
ALEXANDER E. OUTERBRIDGE, metallurgist for William Sellers and Co., Inc., Philadelphia, died January 15 at his home in Chestnut Hill, Philadelphia, at the age of 77. In 1868 he was appointed an assistant in the assay laboratory of the U. S. Mint, Philadelphia, and subsequently established the Assay Department of the branch mint at New Orleans. He was awarded the Elliott Cresson Gold Medal and John Scott Legacy Medal and Premium from the Franklin Institute for original discoveries in the molecular physics of iron. He lectured on industrial economics at the Wharton School of Finance and was an extensive contributor to technical societies and magazines.

ROBERT RANLET, treasurer of the Pfaudler Company, Rochester, died suddenly of heart attack at his home, February 2. He had been with the firm since 1905.

WILLIAM S. GOULD, president of the Fuel Engineering Company of New York, died suddenly in his home at Upper Montclair on January 23. Born in 1865 in Michigan and educated at the University of Michigan, Mr. Gould founded the Fuel Engineering Company and served as its president from 1907 until his death.

EDWARD MALLINCKRODT, chairman of the board of the Mallinckrodt Chemical Works, died of an attack of pneumonia at his home in St. Louis on February 1, after an illness of less than a week. He was in his 84th year.

Born in St. Louis on January 21, 1845, the son of Emil Mallinckrodt, a German immigrant, he soon developed an interest in chemistry which led him to spend three years of study in Germany. After returning in 1867 he organized with his two brothers the firm of G. Mallinckrodt & Company, and began the manufacture of chemicals.



EDWARD MALLINCKRODT

This small business proving profitable the Mallinckrodt Chemical Works was incorporated in 1882 with Edward Mallinckrodt as president. He held this office until several years ago, when he became chairman of the board of directors. In addition he organized the National Ammonia Company in 1889 and became its president.

Outstanding among Mr. Mallinckrodt's numerous philanthropics were his donation of $500,000 to Harvard University for a building to house the department of chemistry and his share in establishing the radiological institute at Washington University of which he was a director.

WILFRID A. HORTON, assistant engineer of the Ajax Electrothermic Corporation of Trenton, N. J., was killed on February 6 when the automobile, in which he and Dr. E. F. Northrup, vice-president of the same company, were driving, was struck at a railroad crossing. Mr. Horton was 26 years old. He was born in England and had been in this country for only a few years.

SENTER M. JONES, first vice-president, manager of purchases, and member of the executive committee of Century Electric Company, St. Louis, died very suddenly on December 11, at the age of 47. Mr. Jones entered the organization in 1906.

HERMAN LANDENBERGER, for 28 years secretary, treasurer, and purchasing agent of the Denver Fire Clay Company, died on January 21.

INDUSTRIAL NOTES

THE AMERICAN FLUORIDE COMPANY, formerly a subsidiary of the Superfos Company, has become an independent firm under the guidance of Dr. Julius Jungmann, president.

THE WELLMAN-SEAVER-MORGAN COMPANY, Cleveland, Ohio, announces the removal of its New York office from 522 Fifth Ave., to 30 Church St.

THE PENNSYLVANIA SALT MANUFACTURING COMPANY announces the election of its vice-presidents, N. M. Bartlett and Y. F. Hardcastle, to the position of vice-president of the Michigan Electrochemical Company and the Tacoma Electrochemical Company.

THE BAILEY METER COMPANY, Cleveland, Ohio, has appointed M. Greenberg acting manager of its Pittsburgh office. E. Brosius, formerly manager, sailed for Durban, South Africa, to take charge of a new installation.

THE INTERNATIONAL OXYGEN COMPANY announces the election by the board of directors of A. A. Heller, president, Sol Heller, vice-president, Samuel Heller, vice-president, and John Heller, secretary and treasurer.

THE BRAUN CORPORATION, Los Angeles, Cal., announces that its representative, J. L. Phillips, is making a tour around the world.

CANADA CARBIDE COMPANY, LIMITED, and Canadian Electro Products Company, Limited, will carry on their business under the name of Shawinigan Chemicals, Limited, Montreal.

THE BLAW-KNOX COMPANY has merged with the Andrews-Bradshaw Company, Pittsburgh, under the former name.

THE KEWAUNEE MANUFACTURING COMPANY has appointed Arthur J. Meeker, formerly with the Alberene Stone Company, its special representative in New York City.

THE GENERAL CERAMICS COMPANY, New York City, has opened a district sales office at 208 South LaSalle Street, Chicago, under Robert S. Beecher.

THE A. E. STALEY MANUFACTURING COMPANY, Decatur, Ill., will begin operation of a new research laboratory and semi-plant experimental station.

THE DRIVER-HARRIS COMPANY has opened an office at 7016 Euclid Ave., Cleveland, under L. H. Waldrip.

THE LINK-BELT COMPANY announces the appointment of four vice-presidents: George P. Torrence, George L. Morehead, Frank B. Caldwell, and W. C. Carter.

THE DITZLER COLOR COMPANY is now located at 8000 West Chicago Boulevard, Detroit, Michigan.

THE BURNDY ENGINEERING COMPANY, New York City, has been appointed distributor of Everdur by the American Brass Company.

THE ROLLWAY BEARING COMPANY has opened a sales office at 614 Empire Building, Pittsburgh, under the charge of Samuel Farrell.

THE ALLIS-CHALMERS MANUFACTURING COMPANY has opened a district sales office at Phoenix, Ariz., and branch offices at San Antonio, Texas, and Grand Rapids, Michigan.

THE C. O. BARLETT & SNOW COMPANY has appointed William W. Dodge, formerly of the Dodge Manufacturing Company its sales representative in western New York.

THE HENDRICK MANUFACTURING COMPANY, Carbondale, Pa., has opened a district office at 223 Railway Exchange Building, Chicago, in charge of Lon Sloan.

THE W. A. JONES FOUNDRY & MACHINE COMPANY has eelcted G. W. Page vice-president and William F. Coleman treasurer.

JULIAN F. AND IRENE F. SMITH, 138 Bachtel Ave., Akron, Ohio, announce a new service, designed to minimize for technical men the labor and expense of keeping up with technical progress. In recognition of the impossibility, for a busy technical man, of reading all the periodicals and patent announcements pertaining to his work, this method will divide chemical technology into about 35 classes, and a monthly digest of the literature in each class will be issued in three divisions called "Literature" (A), "Patents" (B), "Books and Pamphlets" (C).

The digest will be issued on sheets punched to fit the standard size loose leaf binders; and each item will be so spaced that it can be clipped and mounted on an index card. Thus the user has a thorough current bibliography of his subject, in form for filing whole or as a card index or both. Extra copies will be supplied for a small extra charge. Original copies of wanted items will be loaned or sold; detailed abstracts or complete translations will be supplied to order, and other accessory services will be offered to facilitate the use of new or old technical literature. These accessory services will be available to all.

MARKET CONDITIONS *and* PRICE TRENDS

Glycerine Prices Weakened by Decline in Consuming Demand

Lower values also are attributed to cheaper methods of production and to increased competition from substitutes.

THE COURSE of the glycerine market during the last year has been marked by steadily downward trend of values. A year ago, open market quotations for C. P. glycerine were 28c. per lb. and upward. At present this material is offered at 17c. per lb. Price changes for other grades of glycerine show proportionate reductions for the period.

Lower prices not only have failed to stimulate demand for glycerine but, to a large extent, the falling off in market values is credited to subnormal consumption. To begin with, call for supplies for anti-freeze purposes fell far below expectations last year. This was an outlet opened up only a few years ago and it had been held, generally, that additional sales to the anti-freeze trade was a development which would assure material increases in glycerine consumption in future years.

IT IS not only in the anti-freeze trade, however, that sales of glycerine have shown a declining tendency. Demand from the largest consuming industry, the manufacturing of explosives, has been curtailed. Factory consumption in general has been reduced and it is evident that competition from other materials has cut deeply into the fields formerly usurped by glycerine. Prominent among the materials which have offered competition to glycerine in glycol. The latter material is desirable in the anti-freeze trade but in addition is reported to be held in high favor by makers of explosives.

Another development of last year and one of considerable significance as a price factor was the establishment of glycerine production from fermentation of molasses. During the war, Germany had recovered glycerine from waste molasses but abandoned the process after fats and oils became available. The American process is said to have been developed to a point where production costs were lowered and the competition offered by sellers of the fermentation product in the last half of 1927 would tend to substantiate this statement.

WHILE imports of glycerine fell off in volume last year, foreign markets were in constant competition and generally, it was possible to buy imported stocks at prices below those quoted by domestic sellers. This condition shows that price declines were world wide and further evidence is found in the drop from £74 per ton for 80 per cent soap lye glycerine in the London market in January, 1927 to £36 per ton in December.

Increased production of glycerine in Europe played an important part in adding to the world's surplus stocks. Estimates place the output of Germany in 1927 at close to 12,000 tons which is more than double what it was in the years following the war. Russia also enlarged its production with an output of 4,250 tons for the 1926-27 fiscal year in comparison with 3,118 tons for the preceding year. Incidentally Russia is reported to have adopted a program which calls for yearly increases in glycerine production. Italy has productive capacity far in excess of home requirements but is holding manufacture within limits.

Factory Production of Glycerine

	80 Per Cent Lb.	Dynamite Lb.	C.P. Lb.
1927.......	122,762,279	49,240,875	59,125,182
1926.......	116,369,207	49,579,408	64,459,610
1925.......	103,406,943	52,658,326	55,447,832
1924.......	95,153,809	37,368,230	53,242,737
1923.......	99,578,781	52,368,999	47,992,025
1922.......	85,337,034	33,907,226	39,912,929
1921.......	63,946,751	26,944,290	30,322,980
1920.......	54,688,295	31,571,047	32,859,844
1919.......	61,792,958	25,655,394	36,692,530

Factory Consumption of Glycerine

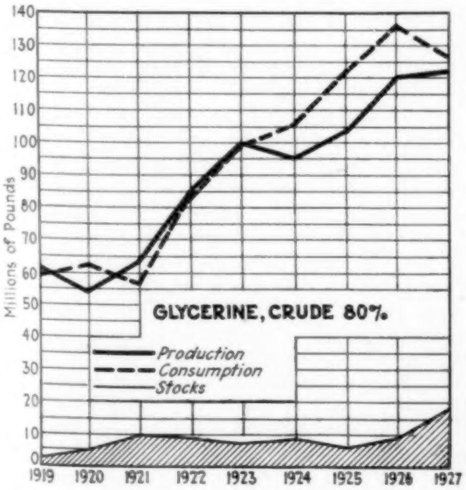
	80 Per Cent Lb.	Dynamite Lb.	C.P. Lb.
1927.......	127,160,880	26,333,010	6,981,726
1926.......	135,798,943	35,466,709	5,805,631
1925.......	122,023,866	47,457,861	5,810,188
1924.......	105,991,503	36,554,914	5,227,247
1923.......	99,766,352	50,580,139	5,262,012
1922.......	84,708,496	29,681,961	4,978,883
1921.......	57,364,402	31,997,374	4,927,536
1920.......	62,515,030	37,720,333	2,714,350
1919.......	58,974,041	28,961,873	1,745,538

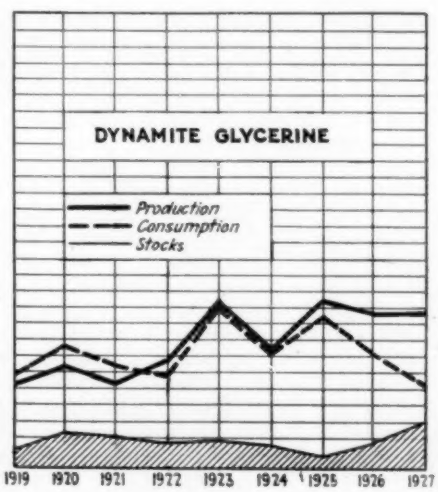
Warehouse Stocks of Glycerine

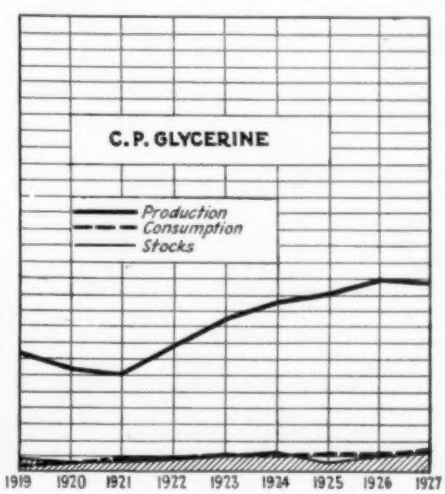
	80 Per Cent Lb.	Dynamite Lb.	C.P. Lb.
1927.......	18,266,458	15,364,323	7,205,168
1926.......	9,452,465	8,654,341	5,346,396
1925.......	5,826,051	4,866,447	3,095,735
1924.......	8,935,558	8,187,539	6,171,551
1923.......	7,413,675	9,835,051	5,468,478
1922.......	9,090,639	9,269,855	4,587,225
1921.......	10,032,145	10,123,330	3,560,236
1920.......	5,081,095	11,801,835	2,767,835
1919.......	2,426,790	5,494,176	4,120,090

Imports of Glycerine

	Crude Lb.	Refined Lb.	Total Lb.
1927.......	21,361,098	12,138,865	33,499,963
1926.......	29,942,635	3,953,418	33,896,053
1925.......	17,259,224	9,444,530	26,703,754
1924.......	9,848,607	256,671	10,105,278
1923.......	12,893,119	500,339	13,393,458
1922.......	2,091,117	75,953	2,167,070
1921.......	11,056,067	3,960,671	15,016,738
1920.......	15,664,109	1,911,278	17,575,387
1919.......	1,163,952	162,916	1,326,868







ECONOMIC INFLUENCES *on production and consumption of* CHEMICALS

Production of Chemicals on Larger Scale Last Month

Improvement in Basic Industries Reflected in Increased Call for Raw Materials

OUTPUT of steel ingots in January was larger than in any month since last May. A gain of more than 25 per cent was registered over the preceding month and more than 5 per cent over January, 1927. Production of byproduct coke was extended, building operations were more active, and improvement generally was reported throughout the basic industries of the country. With consuming industries more active, an increased call for raw materials was a logical sequence and both production and deliveries of chemicals was reported to have gained materially during the period as compared with the latter part of last year. Deliveries of important chemicals against existing contracts ran to heavy tonnage and compared favorably with the movement for the corresponding period of 1927.

Stocks of leather are lower than they were a year ago and the outlook favors large consumption of chemicals in the tanning trade. Production programs of automobile manufacturers would indicate a minimum consumption of 70,000,000 sq.ft. of plate glass in that industry this year. The use of re-inforced glass would increase this total. Pulp and paper production undoubtedly will be curtailed until surplus stocks have been decreased. Rayon manufacture is expanding and demand for chemicals from that quarter promises to make gains this year. Paints and varnishes, including lacquers, are in good demand and should vary but little from last year in consumption of raw materials. The fertilizer trade was inactive for a large part of last year and gives indication of considerable expansion in 1928. The tire industry is in a favorable position and will benefit by enlarged car construction.

ACCORDING to the indexes of the Department of Commerce production of raw materials in December was smaller than in either the preceding month or in December, 1926, but for the year as a whole, the 1927 output of raw products was larger than in 1926, all major groups showing increases over the preceding year except forest products. Manufacturing production in December also showed a decline from both the previous month and December of the preceding year, with the output of manufactures during 1927 registering a decline from the production in 1926. As compared with 1926, the output of all manufacturing groups was lower in 1927 except foodstuffs, textiles, leather, chemicals and oils, stone and clay products and tobacco products, which showed larger output than in the previous year. The greatest decline from 1926 occurred in automobiles.

Stocks of commodities at the end of December, after adjustments for seasonal conditions, were lower than at the end of the preceding month, but showed no change from a year ago. But for a decline from a year ago in the stocks of raw foodstuffs, the general index of commodity stocks at the end of December would have shown an increase over the preceding year, all other groups in the index showing larger stocks than a year ago.

Unfilled orders for manufactured commodities at the end of December were larger than at the end of the preceding month but smaller than a year ago. Forward business on the books of iron and steel manufacturers were larger than at the end of either prior period, while unfilled orders for textiles, although lower than at the end of November, were the same as a year ago. Orders for lumber, unfilled at the end of the year were lower than in either prior period.

OFFICIAL figures showing foreign trade in chemicals and allied products have just been released. The totals, thus presented, give a definite basis for computing the influence of import and export trade upon domestic production. Total exports for 1927 reached a valuation of $131,827,584 as compared with $124,856,478 for 1926. As average values were slightly lower in 1927 than in 1926, it is evident that there was a material gain in export trade as referred to volume and foreign buying, therefore, may be regarded as a factor in increasing domestic production.

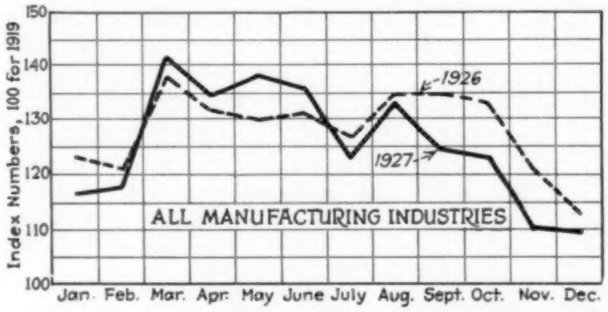
In the coal-tar group marked gains were recorded in shipments of benzol and crude coal-tar and coal-tar pitch. Dyes and other finished products also showed expansion which proved that buying for foreign account was increasingly important to domestic manufacturers. Outward shipments of methanol,acetate of lime, and formaldehyde declined, which, combined with a falling off in domestic trade, does not promise well for the wood distillation branch of the chemical industry. Soda compounds, by virtue of unusually large shipments of borax, made an excellent showing as a group, but other selections, with the exception of silicate of soda, show no trend toward expansion of exports and larger domestic production seems to depend upon enlargement of domestic consumption.

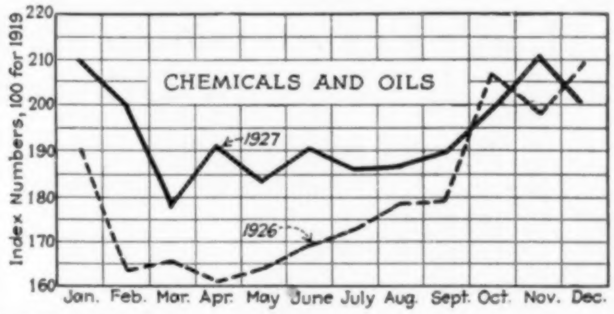
Efforts to expand foreign trade in insecticides, disinfectants, etc., appear to be meeting with success as outward shipments last year far outstripped the totals for 1926. While export trade in glycerine is relatively unimportant, it is significant of increased competition, that foreign markets were less interested in the American product. Pigments, paints, and varnishes registered a gain collectively with carbon black accounting for a large part of the increase. Although showing a loss in valuation, shipments of fertilizers and fertilizer materials made an appreciable gain in tonnage with phosphate rock making this result possible. Foreign buying of sulphate of ammonia was less active than in 1926, largely because Japan reduced its allotment by more than one-half.

Imports of chemicals and related products in 1927 were valued at $129,642,999 as compared with $134,766,440 in 1926. Coal-tar products were entered in larger volume with the largest gain reported for dead or creosote oil. A noteworthy development of the year was the practical elimination of pyridine from the import list during the latter part of the period. Finished coal-tar products, including dyes, also were imported to a smaller extent than in 1926.

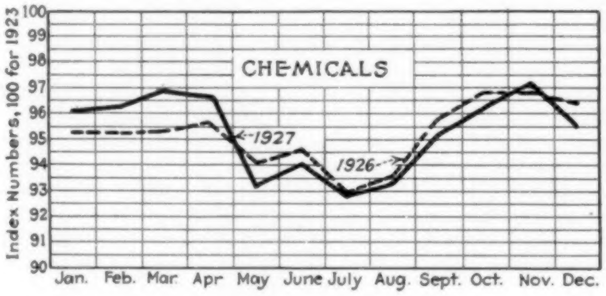
Arrivals of industrial chemicals were valued at $28,368,762 as against a valuation of $28,294,022 for the preceding year. With lower unit values prevailing it is apparent that larger quantities were imported last year than was the case last year. As the majority of selections under this heading are manufactured in this country, the importance of foreign competition is emphasized in its bearing on curtailment of domestic production. Among the acids, larger arrivals of arsenious, formic, and oxalic were noted but smaller offerings of tartaric acid testify to an enlarged domestic output. Ammonia compounds were brought in to a larger extent than in 1926 and even muriate of ammonia, against which domestic producers offered the keenest kind of competition, fell off only about 10 per cent. Potassium chemicals of foreign origin were in larger supply, especially carbonate, caustic, and chlorate which come into competition with domestic makes. Foreign nitrite of soda apparently is unable to overcome the duty handicap and is now of minor importance on our markets.

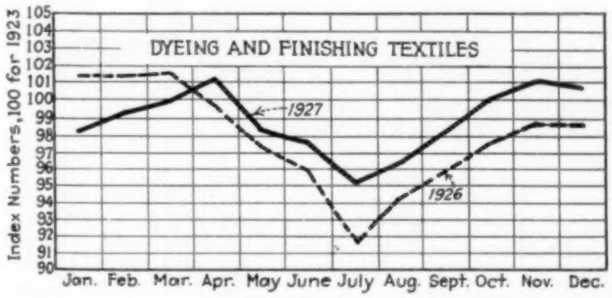
Indexes of Activity in Chemical Producing and Consuming Industries

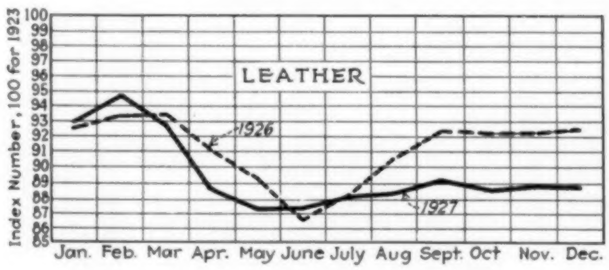


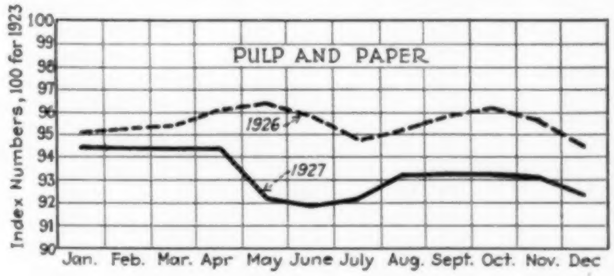


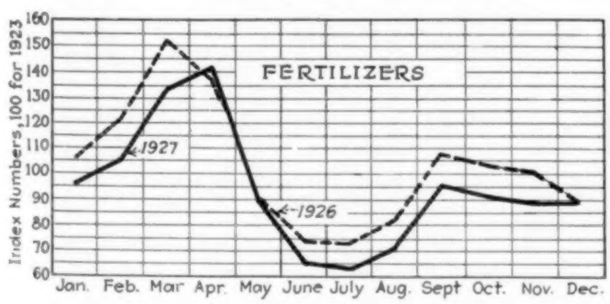
VOLUME OF PRODUCTION (*U. S. Dept. of Commerce*)

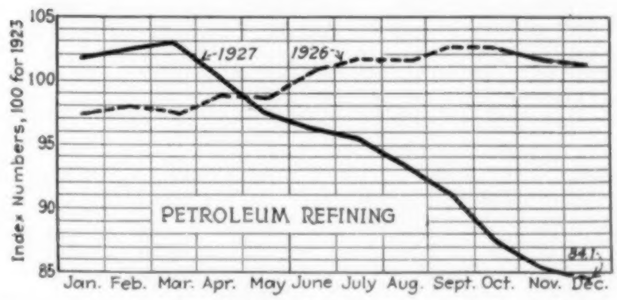




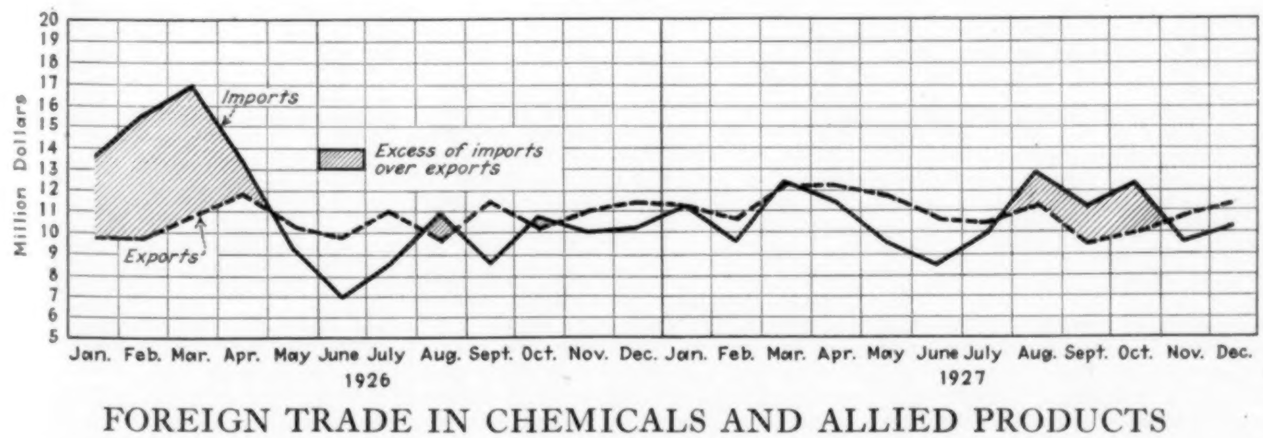








FACTORY EMPLOYMENT (*U. S. Dept. of Labor*)



FOREIGN TRADE IN CHEMICALS AND ALLIED PRODUCTS

MARKET CONDITIONS *and* PRICE TRENDS

Large Consumption of Chemicals Indicated by Deliveries

Shipments Against Existing Contracts Equal Tonnage of a Year Ago

WHILE new business in the market for chemicals has not been active since the turn of the year, there has been an improved call for contract deliveries and in some cases this demand is reported to have exceeded that for the corresponding period of last year. Spotty conditions exist in consuming industries with some more active than a year ago and others lagging. This condition is reflected in the movement of chemicals but in general total consumption is rated about on a par with that of a year ago.

Among the developments of last month was a report that chemists of the prohibition department had developed different non-poisonous adulterants for commercial alcohol. Research work along those lines has been in progress for a long time and the current report shows that considerable progress has been made. No changes in denaturing formulas are anticipated in the near future but ultimately it is probable that the use of methanol will be curtailed. Incidentally low prices for methanol have ruled during the month. Denatured alcohol, on the other hand, has held a steady course with resale offerings smaller than a year ago which condition is expected to continue as a result of controlled production which is to be exercised this year.

Ammonia products are holding a strong position and the market is on a much more stable basis than was the case a year ago. Production is being maintained on a basis commensurate with consuming needs and while producers hold low-priced contracts, recent business has been done at the higher figures quoted and the steadiness of the latter prices testifies to the elimination of price cutting competition. Current price schedules for aqua and anhydrous ammonia show ranges according to deliveries in different zones.

Manufacturers of calcium chloride have issued new and lower sales schedules. No reasons are given for the decline but there have been rumors in the market recently to the effect that this chemical was meeting with competition from other chemicals and possibly this may account for the present price movement. The long-unchanged position of lactic acid also gave way to a lower price level in the early part of the month.

The output of coal-tar crudes and intermediates is going ahead on a large scale and some of these selections are under selling pressure. Cresylic acid maintains a firm position and while buyers are not active, supplies are limited and offerings in foreign producing centers have not increased to a point where importations are affecting values. Benzol has been steadier of late and the same is true for creosote oil and toluol.

TRADING in vegetable oils has been featured by lower price levels. Consumption of cottonseed oil in January failed to come up to expectations and weakness in hog products had a demoralizing effect on values. Refiners bought oil freely at the low levels and under this influence values recovered somewhat but underlying conditions do not give much confidence to the stability of values. Coconut, corn, and peanut oils moved downward under the influence of cottonseed oil.

China wood oil declined in price from the high figures quoted in January but the situation has not clarified to an extent where future prices may be predicted with safety. Values are established in primary markets and there is no assurance that regular shipments will be made from the interior of China to Hankow and other shipping points. Recent cables have indicated that sales in our markets have been made below replacement costs and this can hardly be considered as favoring lower prices in domestic markets in the immediate future.

Linseed oil generally holds firm in price prior to the placing of contracts for spring requirements and this year has been no exception to the rule. Prices have held a low average in recent months but large seed production in the Argentine has encouraged belief that advances would not be made in the present season.

Improvement in Chilean Nitrate Industry

THE improvement in the Chilean nitrate industry during the past year has dispelled to a large extent the fear that in the near future Chilean nitrate will disappear under the competition of synthetic nitrogen products. The setbacks incurred by the Chilean industry during the last few years were the result of the prohibitive price at which sales had been made by the Nitrate Producers' Association, which had existed for some years for the purpose of pooling production and maintaining high prices to give high cost producers an opportunity to operate profitably. Since free selling was restored by the association in April, 1927, a considerable expansion in consumption of the Chilean product has occurred. A reduction of approximately \$10 a ton in the price permitted the Chilean nitrate companies to compete more successfully against synthetic nitrate and sales increased to such an extent that prices have recovered approximately \$3.75 a ton from the lowest levels reached during 1927.

As a result of this improvement the number of nitrate plants in operation increased from 25 in January, 1927, to 55 in November, while the number of workers during the same period increased from 22,800 to 49,600. Prospects for nitrate consumption this spring generally are regarded as very favorable, and judging by the large quantities already sold in consuming markets for spring delivery, a substantial increase in consumption of Chilean nitrate appears probable in nearly all markets. As a result, nitrate exports for 1928 now are estimated at 2,700,000 tons, which also is the amount exported during 1913, the last pre-war normal year for nitrate exports.

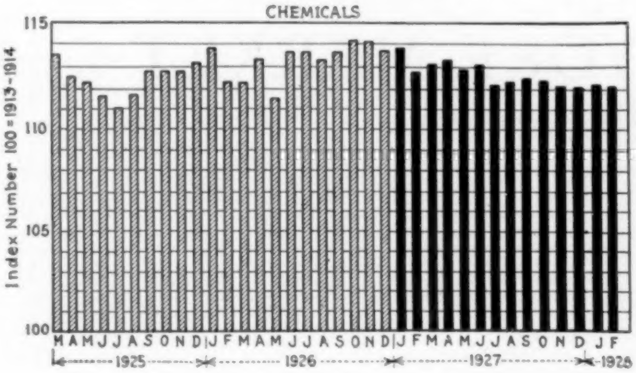
Exports of Chemicals

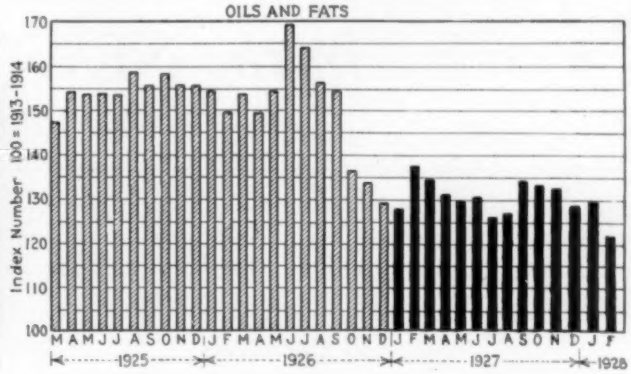
	December 1927	December 1926
Benzol, gal	2,289,177	3,023,326
Crude coal-tar and pitch, bbl	60,916	106,643
Acid, sulphuric, lb	541,263	638,607
Other acids, lb	2,113,157	1,721,271
Methanol, gal	39,369	8,704
Ammonia and compounds, lb	328,527	695,743
Aluminum sulphate, lb	3,498,813	3,253,967
Acetate of lime, lb	2,078,166	674,620
Calcium carbide, lb	258,863	271,025
Bleaching powder, lb	753,809	1,140,576
Copper sulphate, lb	905,584	297,432
Formaldehyde, lb	378,254	236,684
Potassium compounds, lb	351,541	136,256
Sodium bichromate, lb	1,004,485	887,799
Sodium cyanide, lb	235,026	175,055
Borax, lb	7,102,295	1,863,843
Sodium silicate, lb	3,999,048	3,494,392
Sal soda, lb	825,103	687,834
Caustic soda, lb	12,096,217	11,225,146
Bicarbonate of soda, lb	1,328,650	1,440,251
Sulphate of ammonia, ton	8,458	15,502
Sulphur, ton	56,315	45,301

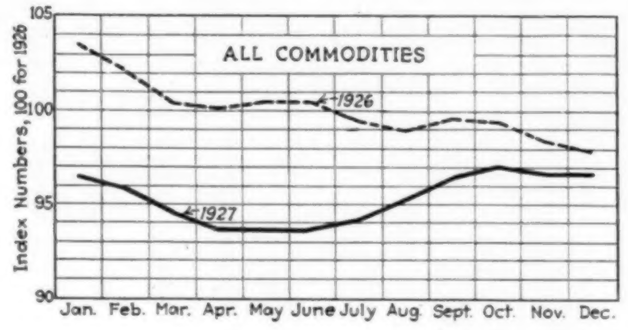
Imports of Chemicals

	December 1927	December 1926
Dead or creosote oil, gal	9,047,119	3,313,429
Pyridine, lb	....	24,911
Coal-tar acids, lb	623,639	3,000
Coal-tar intermediates, lb	90,683	120,440
Arsenic, lb	944,904	343,721
Acid, citric, lb	2,800	....
Acid, formic, lb	192,808	236,808
Acid, oxalic, lb	120,864	102,173
Acid, sulphuric, lb	1,039,773	2,867,367
Acid, tartaric, lb	266,896	78,400
Ammonium chloride, lb	759,490	2,531,271
Ammonium nitrate, lb	596,779	1,327,558
Barium compounds, lb	1,232,314	1,059,664
Calcium carbide, lb	50,000	1,662,155
Cobalt oxide, lb	57,100	24,630
Copper sulphate, lb	391,400	144,197
Bleaching powder, lb	136,480	585,273
Lime citrate, lb	....	....
Glycerine, crude, lb	387,750	1,341,457
Glycer ne, refined, lb	686,244	966,327
Magnesium compounds, lb	1,479,153	1,970,520
Potassium cyanide, lb	17,333	3,478
Potassium carbonate, lb	1,192,192	881,182
Potassium nitrate, ton	309	....
Caustic potash, lb	1,359,889	1,271,297
Cream of tartar, lb	33,695	44,800
Potassium chlorate, lb	1,206,944	978,180
Sodium cyanide, lb	2,174,480	2,067,556
Sodium ferrocyanide, lb	57,631	55,878
Sodium nitrate, ton	66,546	63,663
Sodium nitrite, lb	38,866	20,334
Sulphate of ammonia, ton	1,154	208

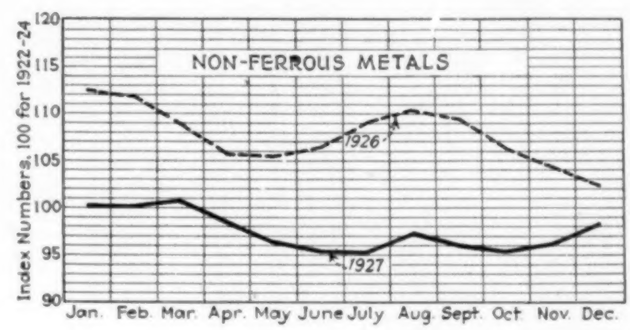
CHEM. & MET. *Weighted Indexes of* PRICES







U. S. Dep't of Labor



Engineering & Mining Journal

Contract Placements Have Steadying Effect on Values for Chemicals

WITH CONSUMERS adopting a policy of covering a large part of their requirements for the year on a contract basis, selling pressure is reduced in the market for many important selections and fluctuations in spot prices exert only minor influence on average values. This is the condition of the present market and there is no indication of important price changes for the immediate future. Later developments will bring out the enforcement of the law of supply and demand but with surplus stocks not burdensome a steady market seems in prospect for the first quarter of the year.

Contract prices for soda ash were slightly lower for 1928 delivery and as ash is a raw material for many chemicals, this may be regarded as a guarantee against advances in price. On the other hand, producers of sulphur are nearly free from low-priced sales contracts and acid manufacturers will operate this year on higher-priced material. Firmer markets for sulphuric acid may follow. Chlorine is selling below the levels of last year with a recovery in price improbable because of keener competition. Ammonia has been placed in a better position both because of enlarged outlets and also because production is more closely in line with consumption. Bichromates have been kept at relatively low levels in recent years and while declines are improbable, producers appear satisfied with present prices.

Methanol has passed through a demoralizing period but prospects are not brighter for the crude material. Competition with synthetic material divided the field for the refined product and recent disclosures show the possibility that crude methanol may ultimately be displaced as an adulterant for alcohol. Reports of intensive research into the development of spray paints for outdoor application have been discussed from the standpoint of the effect on consumption of some of the chemical pigments.

Chem. & Met. Weighted Index of Chemical Prices

Base = 100 for 1913-14

This month	**112.11**
Last month	112.25
February, 1927	112.79
February, 1926	113.86

The more important chemicals are unchanged in price with contract quotations a steadying factor. Fluctuations in other chemicals favored a slight decline in the weighted index number with revised figures for coal-tar acids, tin salts, and methanol.

MARKET values for oils and fats declined sharply in the last month. Cottonsed oil, which ranks first from a tonnage standpoint, has been a leader in the decline with large unsold stocks as a basic reason for the reduction. The downward movement was precipitated, however, by unusually large receipts of hogs at packing centers and the consequent increase in supplies of lard and other fats. Low levels are expected to hold for some time with far off positions for cottonseed oil depending on reports from the next cotton crop.

Paint making oils are more free from competition than are the edible oils and values are based more directly on the supplies of raw materials. Linseed oil has held a steady course in recent weeks and future prices will depend largely on the attitude that European buyers take in the Argentine market. The world's supply of flaxseed is large enough to prevent any drastic upward movement of prices for oil. China wood oil is affected by conditions in China and it is difficult to form an estimate of the probable movement from the interior to shipping terminals.

Chem. & Met. Weighted Index of Prices for Oils and Fats

Base = 100 for 1913-14

This month	**122.02**
Last month	129.76
February, 1927	137.14
February, 1926	149.34

Lower Price levels were almost general in the oils and fats markets. Crude cottonseed oil led the decline and had a weakening effect on coconut, peanut and palm oils. China wood oil was lower in price with linseed oil slightly higher.

CURRENT PRICES *in the* NEW YORK MARKET

For Chemicals, Oils and Allied Products

The following prices refer to round lots in the New York Market. Where it is the trade custom to sell f.o.b. works, quotations are given on that basis and are so designated. Prices are corrected to February 13.

Industrial Chemicals

		Current Price	Last Month	Last Year
Acetone, drums	lb.	$0.13 -$0.14	$0.13 -$0.14	$0.12 -$0.13
Acid, acetic, 28%, bbl.	cwt.	3.38 - 3.63	3.38 - 3.63	3.25 - 3.50
Boric, bbl	lb.	.08½- .08¾	.08½- .08¾	.08½- .11
Citric, kegs	lb.	.44½- .45	.44½- .45	.45 - .47
Formic, bbl.	lb.	.11 - .12	.10½- .11	.10½- .11
Gallic, tech., bbl	lb.	.50 - .55	.50 - .55	.45 - .50
Hydrofluoric 30% carb.	lb.	.06 - .07	.06 - .07	.06 - .07
Lactic, 44%, tech., light, bbl.	lb.	.13 - .14	.13½- .14	.13½- .14
22%, tech., light, bbl.	lb.	.06 - .07	.06½- .07	.06½- .07
Muriatic, 18°, tanks	cwt.	.85 - .90	.85 - .90	.85 - .90
Nitric, 36°, carboys	lb.	.05 - .05½	.05 - .05½	.05 - .05½
Oleum, tanks, wks.	ton	18.00 -20.00	18.00 -20.00	18.00- 20.00
Oxalic, crystals, bbl.	lb.	.11 - .11½	.11 - .11½	.10½- .11
Phosphoric, tech., c'bys.	lb.	.08½- .09	.08½- .09	.08½- .09½
Sulphuric, 60°, tanks	ton	11.00 -11.50	11.00 -11.50	10.50 -11.00
Tannic, tech., bbl	lb.	.35 - .40	.35 - .40	.35 - .40
Tartaric, powd., bbl	lb.	.35 - .36	.36 - .37½	.29 - .30
Tungstic, bbl	lb.	1.00 - 1.20	1.00 - 1.20	1.00 - 1.20
Alcohol, ethyl, 190 p'f., bbl.	gal.	2.70½- 2.75	2.70½- 2.75	2.75 - 3.00
Alcohol, Butyl, dr	lb.	.19½- .20½	.19 - .20½	.18½- .19
Denatured, 190 proof No. 1 special dr	gal.	.48 -......	.48	.31 -...
No. 5, 188 proof, dr.	gal.	.48 -......	.48	.31 - .32
Alum, ammonia, lump, bbl	lb.	.03½- .04	.03½- .04	.03½- .04
Chrome, bbl	lb.	.05½- .05¾	.05½- .05¾	.05½- .06
Potash, lump, bbl	lb.	.02¾- .03½	.02¾- .03½	.02½- .03½
Aluminum sulphate, com., bags	cwt.	1.40 - 1.45	1.40 - 1.45	1.40 - 1.45
Iron free, bg	cwt.	2.00 - 2.10	2.00 - 2.10	2.00 - 2.10
Aqua ammonia, 26°, drums	lb.	.03 - .04	.03 - .04	.03½- .04
Ammonia, anhydrous, cyl.	lb.	.13½-......	.13½-......	.13 - .15
Ammonium carbonate, powd. tech., casks	lb.	.10½- .14	.10½- .14	.11 - .14
Sulphate, wks.	cwt.	2.40 -......	2.40 -	2.50 -......
Amylacetate tech., drums	gal.	1.75 - 2.00	2.15 - 2.20	1.80 - 1.90
Antimony Oxide, bbl.	lb.	.13½- .15	.13½- .15	.14½- .15
Arsenic, white, powd., bbl.	lb.	.04 - .04½	.04 - .04½	.03¾- .04½
Red, powd., kegs	lb.	.09 - .10	.09½- .10	.11 - .12
Barium carbonate, bbl.	ton	48.00 -50.00	48.00 -50.00	48.00 -50.00
Chloride, bbl.	ton	56.00 -58.00	58.00 -60.00	63.00 -65.00
Nitrate, cask	lb.	.08 - .08½	.08 - .08½	.07½- .08
Blanc fixe, dry, bbl	lb.	.04 - .04½	.04 - .04½	.04 - .04½
Bleaching powder, f.o.b., wks., drums	cwt.	2.00 - 2.10	2.00 - 2.10	2.00 - 2.10
Borax, bbl.	lb.	.04 - .04½	.04½- .05	.05 - .05½
Bromine, cs.	lb.	.45 - .47	.45 - .47	.45 - .47
Calcium acetate, bags	cwt.	3.50 -......	3.50 -......	3.25 - 3.50
Arsenate, dr	lb.	.06½- .07	.07½- .08	.07½- .08
Carbide drums	lb.	.05 - .06	.05 - .06	.05 - .06
Chloride, fused, dr., wks.	ton	20.00 -....	21.00 -....	21.00 -......
Phosphate, bbl.	lb.	.07 - .07½	.07 - .07½	.07 - .07½
Carbon bisulphide, drums	lb.	.05 - .06	.05½- .06	.05½- .06
Tetrachloride drums	lb.	.06¾- .07	.06¾- .07	.06½- .07
Chlorine, liquid, tanks, wks.	lb.	.03½- .04½	.04 - .04½	.04 - .04½
Cylinders	lb.	.05½- .08	.05½- .08	.05½- .08
Cobalt oxide, cans	lb.	2.10 - 2.20	2.00 - 2.10	2.10 - 2.25
Copperas, bgs., f.o.b. wks.	ton	16.00 -17.00	14.00- 17.00	13.00 -15.00
Copper carbonate, bbl	lb.	.17 - .17½	.17 - .18	.16¾- .17
Cyanide, tech., bbl	lb.	.49 - .50	.49 - .50	.49 - .50
Sulphate, bbl.	cwt.	5.05 - 5.10	5.05 - 5.10	4.90 - 5.00
Cream of tartar, bbl.	lb	.27½- .28	.27½- .28	.21 - .22
Diethylene glycol, dr.	gal.	.10 - .15	.15 - .20	.... - ....
Epsom salt, dom., tech., bbl.	cwt.	1.75 - 2.15	1.75 - 2.00	1.75 - 2.00
Imp., tech., bags	cwt.	1.15 - 1.25	1.15 - 1.25	1.35 - 1.40
Ethyl acetate, 85% drums	gal.	.74 - .76	.74 - .76	.74 - .76
Formaldehyde, 40%, bbl.	lb.	.08½- .08½	.08½- .11½	.09 - .09½
Furfural, dr.	lb.	.15 - .17½	.15 - .17½	.15 - .17
Fusel oil, crude, drums	gal.	1.30 - 1.40	1.30 - 1.40	1.40 - 1.50
Refined, dr	gal.	2.50 - 3.00	2.50 - 3.00	2.50 - 3.00
Glaubers salt, bags	cwt.	1.10 - 1.20	1.00 - 1.10	1.20 - 1.40
Glycerine, c.p., drums, extra.	lb.	.17½- .18	.19 - .20	.28 -......
Lead:				
White, basic carbonate, dry, casks	lb.	.08½-......	.09 -......	.10¾-......
White, basic sulphate, sck.	lb.	.07¾-......	.08½-......	.09½-......
Red, dry, sck	lb.	.10 -......	.10 -......	.11¾-......
Lead acetate, white crys., bbl.	lb.	.13 - .13½	.13 - .13½	.14½-......
Lead arsenate, powd., bbl.	lb.	.12 - .13	.12 - .13	.14 - .15
Lime, chem., bulk	ton	8.50 -......	8.50 -	8.50 -......
Litharge, pwd., csk	lb.	.09 -......	.09 -	.10¾-......
Lithopone, bags	lb.	.05½- .06	.05½- .06	.05½- .06¼
Magnesium carb., tech., bags	lb.	.07½- .08	.07½- .08	.06½- .06¾
Methanol, 95%, dr	gal.	.43 -... .45	.48 - .50	.85 -......
97%, dr.	gal.	.45 - .47	.50 - .52	.90 -......
Nickel salt, double, bbl.	lb.	.10 - .10	.10 - .10½	.09 - .10
Single, bbl	lb.	.10½- .11	.10½- .11	.10 - .11

		Current Price	Last Month	Last Year
Orange mineral, csk.	lb.	$0.12 -	$0.12 - ...	$0.13½-
Phosphorus, red, cases	lb.	.62 -$0.65	.62 -$0.65	.65 -$0.68
Yellow, cases	lb.	.32 - .33	.32 - .34	.33 - .34
Potassium bichromate, casks.	lb.	.08½- .08¾	.08½- .08¾	.08½- .08¾
Carbonate, 80-85%, calc., csk.	lb	.05¾- .06	.05¾- .06	.06½- .06¾
Chlorate, powd.	lb.	.08½- .09	.08½- .09	.08½- .09
Cyanide, cs.	lb.	.55 - .57	.55 - .58	.55 - .57
First sorts, csk.	lb.	.09 - .09½	.08¾- .09	.08¾- .09
Hydroxide (c'stic potash) dr.	lb.	.07½- .07¾	.07½- .07¾	.07½- .07¾
Muriate, 80% bgs	ton	36.40 -...	36.40 -...	36.00 -.....
Nitrate, bbl.	lb.	.06 - .06½	.06 - .06½	.06 - .07½
Permanganate, drums.	lb.	.15 - .15	.14 - .15	.14½- .15
Prussiate, yellow, casks.	lb.	.18 - .19	.18½- .19	.18 - .19
Sal ammoniac, white, casks.	lb.	.047- .05	.047- .05	.05¾- .06
Salsoda, bbl.	cwt.	.90 - .95	.90 - .95	.90 - .95
Salt cake, bulk.	ton	17.00 -18.00	17.00 -18.00	17.00 -19.00
Soda ash, light, 58%, bags, contract	cwt.	1.32 -......	1.32½-.....	1.38 -.....
Dense, bags	cwt.	1.35 -......	1.37½- 1.55	1.45 - 1.55
Soda, caustic, 76%, solid, drums, contract	cwt.	2.80 - 3.00	3.00 -..	3.10 -......
Acetate, works, bbl.	lb.	.04½- .05½	.04¾- .05	.04½- .05
Bicarbonate, bbl.	cwt.	2.00 - 2.25	2.00 - 2.25	2.00 - 2.25
Bichromate, casks	lb.	.06¾- .06½	.06½- .06¾	.06¾- .06¾
Bisulphate, bulk	ton	3.00 - 3.50	5.00 - 5.50	6.00 - 7.00
Bisulphite, bbl	lb.	.03¾- .04	.03¾- .04	.03¾- .04
Chlorate, kegs	lb.	.06¾- .06½	.06½- .06½	.06¾- .06½
Chloride, tech.	ton	12.00 -14.75	12.00- 14.75	12.00 -14.00
Cyanide, cases, dom.	lb.	.18 - .22	.18 - .22	.19 - .22
Fluoride, bbl.	lb.	.09 - .09½	.08½- .09	.08½- .09
Hyposulphite, bbl	lb.	2.50 - 3.00	2.50 - 3.00	2.65 - 3.00
Nitrate, bags	cwt.	2.35 -......	2.35 -...	2.36 -...
Nitrite, casks	lb.	.07½- .08	.07½- .08	.08½- .09
Phosphate, dibasic, bbl.	lb.	.03 - .03½	.03½- .03¾	.03½- .03¾
Prussiate, yel. drums	lb.	.12 - .12½	.12 - .12½	.10 - .10½
Silicate (30°, drums)	cwt.	.75 - 1.15	.75 - 1.15	.75 - 1.15
Sulphide, fused, 60-62%, dr.	lb.	.03½- .04	.03½- .04	.02¾- .03
Sulphite, crys., bbl	lb.	.03 - .03½	.03 - .03½	.02½- .03
Strontium nitrate, bbl.	lb.	.09 - .09½	.08½- .09	.08½- .09
Sulphur, crude at mine, bulk.	ton	18.00 -......	18.00 -......	18.00 -......
Chloride, dr	lb.	.04 - .05	.04 - .05	.05 - .05½
Dioxide, cyl.	lb.	.09 - .10	.09 - .10	.09 - .10
Flour, bag	cwt.	2.70 - 3.00	2.70 - 3.00	2.70 - 3.00
Tin bichloride, bbl.	lb.	.16½-......	.17½-......	.19 -......
Oxide, bbl.	lb.	.60 -......	.62 -......	.67 -......
Crystals, bbl.	lb.	.40 -......	.41 -......	.48 -......
Zinc chloride, gran., bbl.	lb.	.06½- .06¾	.06¾- .06½	.07 - .07½
Carbonate, bbl.	lb.	.10 - .11	.10 - .10½	.10½- .11
Cyanide, dr.	lb.	.40 - .41	.40 - .41	.40 - .41
Dust, bbl.	lb.	.09 - .10	.10¾- .11	.09 - .10
Zinc oxide, lead free, bag.	lb.	.06¾-......	.06¾-......	.07½-......
5% lead sulphate, bags	lb.	.06¾-......	.06¾-......	.07½-......
Sulphate, bbl	cwt.	2.75 - 3.00	2.75 - 3.00	2.75 - 3.00

Oils and Fats

		Current Price	Last Month	Last Year
Castor oil, No. 3, bbl.	lb.	$0.13 -$0.13½	$0.13 -$0.13½	$0.12½-$0.13
Chinawood oil, bbl.	lb.	.17 -......	.18 -......	.17½-......
Coconut oil, Ceylon, tanks, N. Y.	lb.	.08½-......	.08¾-......	.08½-......
Corn oil crude, tanks, (f.o.b. mill)	lb.	.09¾-......	.03¾-......	.08 -......
Cottonseed oil, crude (f.o.b. mill), tanks	lb.	.07½-......	.08½-......	.07¾-......
Linseed oil, raw, car lots, bbl.	lb.	.098-......	.098-......	10.4 -......
Palm, Lagos, casks	lb.	.07¾-......	.08 -......	.08½-......
Niger, casks	lb.	.07½-......	.07½- .07½	.07¾-......
Palm Kernel, bbl.	lb.	.09½-......	.09½-......	.09 -......
Peanut oil, crude, tanks (mill)	lb.	.09½-......	.09½-......	.13 -......
Perilla, bbl	lb.	....-......	....-......	....-......
Rapeseed oil, refined, bbl.	gal.	.86 - .87	.82 - .84	.79 - .80
Sesame, bbl.	lb.	....-......	....-......	....-......
Soya bean tank (f.o.b. Coast)	lb.	.09¾-......	.09¾-......	.09½-......
Sulphur (olive foots), bbl.	lb.	.09½-......	.10 -......	.09½-......
Cod, Newfoundland, bbl	gal.	.63 - .65	.63 - .64	.63 - .65
Menhaden, light pressed, bbl.	gal.	.60 - .66	.60 - .62	.58 - .60
Crude, tanks (f.o.b. factory)	gal.	.40 -	.40 -......	.45 -......
Whale, crude, tanks	lb.	....-......	....-......	......
Grease, yellow, loose	lb.	.07½-......	.07½-......	.06¾-......
Oleo stearine	lb.	.09½-......	.10½-......	.08¾-......
Red oil, distilled, d.p. bbl.	lb.	.09½- .09½	.09½- .10	.09½- .10
Tallow, extra, loose	lb.	.08½-......	.08½-......	.07½-....

Coal-Tar Products

		Current Price	Last Month	Last Year
Alpha-naphthol, crude, bbl.	lb.	$0.60 -$0.65	$0.60 -$0.65	$0.60 -$0.62
Refined, bbl	lb.	.85 - .90	.85 - .90	.85 - .90
Alpha-naphthylamine, bbl.	lb.	.35 - .36	.35 - .36	.35 - .36
Aniline oil, drums, extra	lb.	.15 - .16	.15 - .16	.16 - .16½
Aniline salts, bbl	lb.	.24 - .25	.24 - .25	.22 - .23
Anthracene, 80%, drums	lb.	.60 - .65	.60 - .65	.60 - .65

Coal Tar Products (Continued)

		Current Price	Last Month	Last Year
Benzaldehyde, U.S.P., dr...	lb.	1.15 - 1.25	1.15 -$1.35	1.30 - 1.35
Benzidine base, bbl........	lb.	.70 - .72	.70 - .75	.72 - .74
Benzoic acid, U.S.P., kgs...	lb.	.58 - .60	.58 - .60	.56 - .60
Benzyl chloride, tech, dr....	lb.	.25 - .26	.25 - .26	.25 - .26
Benzol, 90%, tanks, works...	gal.	.24 - .25	.24 - .25	.24 - .25
Beta-naphthol, tech., drums	lb.	.22 - .24	.22 - .24	.22 - .24
Cresol, U.S.P., dr.........	lb.	.18 - .20	.18 - .20	.18 - .20
Cresylic acid, 97%, dr., wks	gal.	.61 - .62	.61 - .62	.60 - .65
Diethylaniline, dr.........	lb.	.58 - .60	.58 - .60	.58 - .60
Dinitrophenol, bbl.........	lb.	.31 - .35	.31 - .33	.31 - .35
Dinitrotoluen, bbl.........	lb.	.17 - .18	.17 - .18	.18 - .20
Dip oil, 25% dr............	gal.	.28 - .30	.28 - .30	.28 - .30
Diphenylamine, bbl........	lb.	.45 - .47	.45 - .47	.48 - .50
H-acid, bbl................	lb.	.63 - .65	.63 - .65	.65 - .66
Naphthalene, flake, bbl.....	lb.	.04½- .05	.04½- .05	.06½- .07
Nitrobenzene, dr..........	lb.	.09 - .10	.09 - .10	.09 - .10
Para-nitraniline, bbl.......	lb.	$0.52 -$0.53	$0.52 -$0 53	$0.50 -$0.53
Para-nitrotoluine, bbl......	lb.	.28 - .32	.28 - .32	.40 - .42
Phenol, U.S.P., drums......	lb.	.18 - .19	.18 - .19	.17 - .18
Picric acid, bbl............	lb.	.30 - .40	.30 - .40	.25 - .26
Pyridine, dr................	lb.	3.00 -......	3.00 -......	3.90 - 4.00
R-salt, bbl.................	lb.	.47 - .50	.47 - .50	.50 - .55
Resorcinal, tech, kegs......	lb.	1.30 - 1.35	1.35 - 1.40	1.30 - 1.40
Salicylic acid, tech., bbl....	lb.	.30 - .32	.30 - .32	.32 - .33
Solvent naphtha, w.w.,tanks	gal.	.35 -...	.35 -......	.35 -......
Tolidine, bbl...............	lb.	.95 - .95	.95 - .96	.90 - .95
Toluene, tanks, works.......	gal.	.35 -...	.35 -...	.35 -....
Xylene, com., tanks	gal.	36 - 41	36 - .41	36 - .40

Miscellaneous

		Current Price	Last Month	Last Year
Barytes, grd., white, bbl.....	ton	$23.00-$25.00	$23.00-$25.00	$23.00-$25.00
Casein, tech., bbl...........	lb.	.17 - .18	.17 - .18	.16 - .17
China clay, dom.,f.o.b. mine	ton	10.00 -20.00	10.00 -20.00	10.00 -20.00
Dry colors:				
Carbon gas, black (wks.)..	lb.	.06½- .07	.06½- .07	.08 - .08½
Prussian blue, bbl	lb.	.31 - .33	.31 - .33	.32 - .33
Ultramine blue, bbl........	lb.	.08 - .35	.08 - .35	.08 - .35
Chrome green, bbl.........	lb.	.27 - .31	.27 - .30	.28 - .30
Carmine red, tins.........	lb.	5.50 - 5.75	5.50 - 5 75	5.10 - 5.85
Para toner....	lb.	.70 - .80	.70 - .80	.90 - .95
Vermilion, English, bbl. ..	lb.	1.80 - 1.85	1.80 - 1.85	1.45 - 1.50
Chrome yellow, C. P., bbl.	lb.	.17 - .18	.17 - .18	.17½- .18
Feldspar, No. 1 (f.o.b. N. C.)	ton	5.75 - 7.00	5 75 - 7.00	6.00 - 6.50
Graphite, Ceylon, lump, bbl	lb.	.07½- .08	.07½- .09½	.09 - .10
Gum copal, Congo, bags....	lb.	.07¾- .08	.07¾- .08	.09½- .10
Manila, bags............	lb.	.15 - .18	.15 - .16	.14 - .10
Damar, Batavia, cases...	lb.	.23 - .24	.23 - .24	.25 - .25
Kauri, No. 1 cases.......	lb.	.48 - .53	.48 - .53	.53 - .56
Kieselguhr (f.o.b. N. Y.)....	ton	50.00 -55.00	50.00 -55.00	50.00 -55 00
Magnesite, calc.	ton	44.00 -......	44.00 -......	38.00 -42.00
Pumice stone, lump, bbl.....	lb.	.05 - .07	.05 - .08	.04½- .06
Imported, casks........	lb.	03 - .40	.03 - .40	.03 - .35
Rosin, H................	bbl.	9 75 -......	8.50 -......	12 25 -......
Turpentine	gal.	.60 -......	.63 -......	.76 -......
Shellac, orange, fine, bags...	lb.	.51 - .52	.59 - .61	.49 - .51
Bleached, bonedry, bags...	lb.	.54 - .56	.61 - .63	.53 - .55
T. N. bags....	lb.	.44 - 45	.55 - .57	.44 - .46
Soapstone (f.o.b. Vt.), bags..	ton	10.00 -12.00	10 00 -12.00	9.00 -11.00
Talc, 200 mesh (f.o.b. Vt.)...	ton	10.50 -...	10.50 -...	10.50 -......
200 mesh (f.o.b. Ga.)......	ton	7.50 -10.00	7 50 -10.00	7.50 -11.00
325 mesh (f.o.b. N. Y.)....	ton	13.75 -......	13.75 -	14.75 -....

		Current Price	Last Month	Last Year
Wax, Bayberry, bbl.........	lb.	$0.23½-$0.24	$0.23½-$0.26	$0.25 -$0.26
Beeswax, ref., light.......	lb.	.43 - .45	.43 - .47	.46 - .47
Candelilla, bags...........	lb.	.25 - .27	.27 - .28	.34 - .35
Carnauba, No. 1, bags....	lb.	.54 - .55	.55 - .60	.70 - .72
Paraffine, crude				
105-110 m.p............	lb.	.04¾- .05	.04¾- .05	.05½- .06

Ferro-Alloys

		Current Price	Last Month	Last Year
Ferrotitanium, 15-18%......	ton	$200.00-.....	$200.00-.....	$200.00-...
Ferromanganese, 78-82%....	ton	100.00-.....	100.00-.....	88.00-90.00
Spiegeleisen, 19-21%........	ton	31.00-32.00	30.00-31.00	33.00-34.00
Ferrosilicon, 10-12%........	ton	33.00-38.00	33.00-38.00	33.00-38.00
Ferrotungsten, 70-80%......	lb.	.95- 1.00	.95- 1.00	1.05- 1.10
Ferro-uranium, 35-50%.....	lb.	4.50-...	4.50-.....	4.50-.....
Ferrovanadium, 30-40%.....	lb.	3.15- 3.75	3.15- 4.00	3.25- 3.75

Non-Ferrous Metals

		Current Price	Last Month	Last Year
Copper, electrolytic..........	lb.	$0.13½-......	$0.13½ -.....	$0.14¾-......
Aluminum, 96-99%.........	lb.	.25 - .26	.26 - .27	.27 - .28
Antimony, Chin. and Jap...	lb.	.10¾- .11	.11 - .11½	.13¾-......
Nickel, 99%................	lb.	.35 -...	.35 -......	.35 -......
Monel metal, blocks.........	lb.	.32 - .33	.32 - .33	.32 - .33
Tin, 5-ton lots, Straits......	lb.	.52¾-......	.56½-......	.64½-......
Lead, New York, spot......	lb.	6.30 -......	6.50 -......	8.40 -......
Zinc, New York, spot.......	lb.	6.00 -......	5.95 -......	7.65 -......
Silver, commercial..........	oz.	.57¾-.....	.57¾-......	.63¾-......
Cadmium..................	lb.	.60 -...	.60 -......	.60 -......
Bismuth, ton lots..........	lb.	1.85 - 2.10	1.85 - 2.00	2.70 - 2.75
Cobalt....................	lb.	2.50 -....	2.50 -.....	3.00
Magnesium, ingots, 99%....	lb.	.75 - .80	.75 - .80	.75 - .80
Platinum, ref..............	oz...	85.00-....	82 00-...	111.00-......
Palladium, ref.............	oz.	50.00- 52.00	52.00- 53.00	68.00-70.00
Mercury, flask...........75	lb.	121.00-......	124.00-	101.00-......
Tungsten powder..........	lb.	1.05- 1.15	1.05-......	1.10-......

Ores and Semi-finished Products

		Current Price	Last Month	Last Year
Bauxite, crushed, wks.......	ton	$5.50- $8.50	$5.50- $8.50	$5.50- $8.75
Chrome ore, c.f. post........	ton	22.00- 24.00	22.00- 24.00	22.00- 23.00
Coke, fdry., f.o.b. ovens....	ton	3.75- 4.25	3.75- 4.25	3.75- 4.25
Fluorspar, gravel, f.o.b. Ill....	ton	17.00- 18.00	17.00-....	18.00-......
Ilmenite, 52% TiO_2, Va.....	lb.	.00¾ .00¾	00¾ .00¾	.01½-.....
Manganese ore, 50% Mn., c.i.f. Atlantic Ports.......	unit	.36 - 38	36 - .38	.40 - 42
Molybdenite, 85% MoS_2 per lb. MoS_2, N. Y..........	lb.	48 - .50	48 - .50	.65- .70
Monazite, 6% of ThO_2......	ton	120.00-......	120.00-.....	120.00-......
Pyrites, Span. fines, c.i.f.....	unit	.13¾-..	.13½-....	.13½-......
Rutile, 94-96% TiO_2........	lb.	.11 - .13	.11 - .13	.12 - .15
Tungsten, scheelite, 60% WO_3 and over.......	unit	10.50 -10.75	10.35 -10 50	11.00 -11.25
Vanadium ore, per lb. V_2O_5.	lb.	.25 - .28	.25 - .30	.30 - .35
Zircon, 99%	lb.	.03 -......	.03 -....	.03 -......

Current Industrial Developments

New Construction and Machinery Requirements

Acid Factory—Owner, c/o C. V. Badger, 191 Merrimack St., Haverhill, Mass., Archt., is having revised plans prepared for a 2 story, 60 x 110 ft. acid factory. Estimated cost $65,000.

Barium Sulphate Plant — The Sudbury Basin Co., c/o Stoble Furlong Co. Ltd., Insurance Exchange Bldg., Montreal, Que., C. D. H. McAlpine, Secy., has acquired barium sulphate deposits at Javis Island, about forty miles from Port Arthur, Ont., and plans the construction of a plant. The material is to be used in conjunction with zinc for the manufacture of lithophone. Estimated cost $100,000.

Carbon Black Plant—Kosmos Carbon Co., Union Trust Bldg., Charleston, W. Va., will build a carbon black plant at Borger, Tex., by day labor. Machinery and equipment will be required.

Carbon Black Plants and Casinghead Gasoline Plant — Phillips Petroleum Co., Bartlesville, Okla., has been granted permit by the Railway Commission to construct three plants for the manufature of carbon black from residue casinghead gas including machine shops, pipe lines, etc. in Hutchinson, Carson and Gray counties, Tex.; plant 1 in Hutchinson-Carbon counties to consume a maximum of 50,000,000 and minimum of 20,000,000 cu.ft.; plant 2 located south of Pampa in Gray county to consume a maximum of 25,000,000 and minimum of 10,000,000 cu.ft.; plant 3 in Hutchinson county to consume a maximum of 12,000,000 and minimum of 8,000,000 cu.ft. $200,000 each, also plans a new casinghead gasoline plant in western Hutchinson county. $200,000. Work will probably be done by day labor.

Cement Plant—Carney Cement Co., Mankato, Minn., awarded contract for a cement plant to J. B. Nelson Construction Co., Mankato, Minn. Estimate cost $105,600.

Cement Plant—The Lehigh Portland Cement Co., c/o F. C. Fish, Industrial Engr., Allentown, Pa., plans the construction of a cement plant along Cuyahoga River, Cleveland, O. Estimated cost $1,000,000.

Cement Plant — Monolith Portland Cement Co., Bartlett Bldg., Los Angeles, Calif., plans extensions and improvements to cement plant at Bakersfield, Calif. Estimated cost $350,000.

Cement Plant—The Pacific Coast Cement Co., subsidary of the Pacific Coast Co., L. C. Smith Bldg., Seattle, Wash., plans the construction of a cement plant on Duwamish waterway. Estimated cost $3,000,000.

Cement Plant—W. Tucker, F. Robertson, Los Angeles, Calif. and C. Burnett, San Diego, Calif., plan a cement plant at Aransas Pass, Tex. Estimated cost $300,000. Machinery and equipment will probably be required.

Chemical Plant—Oelwein Chemical Co., Oelwein, Ia., awarded contract for a 2 story, 70 x 120 and 70 x 150 ft. chemical plant to George Netcott, Oelwein, Ia. Estimated cost $50,000.

Chemical Factory—E. R. Squibb & Sons, 80 Beekman St., New York, N. Y., awarded contract for a 12 story, 98 x 164 ft. chemical factory at Brooklyn, N. Y., to White Construction Co., 95 Madison Ave., New York, N. Y. Estimated cost $500,000.

Chemistry Building—W. C. Hedrick, 1105 National Bank Bldg., Fort Worth, Tex., Archt., will receive bids for a chemistry building at Lubbock, Tex., for Texas Technical College, c/o A. P. Horn, Pres. Estimated cost $275,000.

Chemistry Building — Ohio State University, Columbus, O., will soon award contract for a 4 story, 84 x 153 ft. chemistry building. J. N. Bradford, 55 East Oakland Ave., Columbus, O., is architect.

Chemistry Building — Phillips Exeter Academy, Exeter, N. H., plans the construction of a chemistry building. Cram & Ferguson, 248 Boylston St., Boston, Mass., are architects.

Citrus Packing Plant—Olive Heights Citrus Assn., Olive, Calif., is having plans prepared for a 1 story, 150 x 200 ft. citrus packing plant. Estimated cost $60,000. E. M. Mahl, Highgrove, Calif., is architect.

Coke Oven Gas Plant—United Gas Improvement Co., Broad and Arch Sts., Philadelphia, Pa., awarded contract for a coke oven gas plant to The Koppers Co., Union Trust Bldg., Pittsburgh. Estimated cost $8,000,000.

Coke Ovens, Etc.—Gulf States Steel Co., Alabama City, Ala., plans extensions and improvements to plant including coke ovens, finishing mills, power plant, etc. Estimated cost $3,000,000. Dwight P. Robinson & Co. Inc., 129 East 46th St., New York, N. Y., are engineers.

Coke Screening Plant—Citizens Gas Co., C. L. Kirk, Gen. Mgr., 47 South Penn St., Indianapolis, Ind., is having plans prepared for the construction of a coke screening plant, also extensions to feeder gas mains. Estimated cost $345,000.

Coking Plant—Canadian Coke Co. Ltd., St. John, N. B., plans the construction of a coking plant. Estimated cost $500,000.

Coking Plant—Nova Scotia Tramway & Power Co. Ltd., c/o K. L. Dawson, Engr., Halifax, N. S., plans the construction of a coking plant. Estimated cost $160,000.

Compressed Gas Plant—Linde Air Products Co., 30 East 42nd St., New York, N. Y., plans the construction of a 1 story, 80 x 120 ft. compressed gas plant at Erie, Pa. Estimated cost $150,000. Private plans.

Condensed (Milk) Plant—Borden Farm Products Co., 110 Hudson St., New York, N. Y., awarded contract for a 2 story, 115 x 315 ft. condensed milk plant at Macon, Miss. to H. K. Ferguson Co., 4900 Euclid Ave., Cleveland, O. Estimated cost $135,000.

Copper Factory—Taunton-New Bedford Copper Co., J. H. Barrows, New Bedford, Mass., awarded contract for a 2 story copper factory on North Front St. to J. E. Cox Co., North Main St., Fall River, Mass.

Cottonseed Plant—Texas Refining Co., J. B. Clayton, Pres., 3000 Gravis St., Greenville, Tex., plans the construction of a 70 x 200 ft. cottonseed plant. B. D. Denny, c/o owner, is engineer. Machinery and equipment including motors, elevating and conveying machines, etc. to cost $16,000 will be required.

Cyanamid Factory—American Cyanamid Co., G. A. Cox, Gen. Mgr., Niagara Falls, Ont., awarded contract for steel for a 2 story, 60 x 125 and 60 x 85 ft. factory on Second Ave. N. Estimated cost $200,000. Private plans. Work will be done under the supervision of owners. Equipment for the manufacture of fertilizers will be required.

Gas Plant Extensions—Kansas City Gas Co., 910 Grand Ave., Kansas City, Mo., plans to expend $1,000,000 during 1928 for extensions and improvements to gas plant.

Gas Plant and Lines—Knoxville Gas Co., H. B. Bonner, Gen. Mgr., c/o H. L. Doherty Co., 60 Wall St., New York, N. Y., plans development to cover 8 year period including construction of gas plant, also extensions to lines at Knoxville, Tenn. Estimated total cost $2,000,000. Engineering Dept. of H. L. Doherty Co. in charge. First unit to cost $500,000 will be built in 1928.

Glass Factory—Illinois Pacific Glass Corp., 14th and Folsom Sts., San Francisco, Calif., plans the construction of a glass factory at Vernon, Calif. Estimated cost $500,000.

Gummed Products Factory—Gummed Products Co., Troy, O., awarded contract for a 1 story, 50 x 60 ft. gummed products factory on South Union St. to A. E. Brown & Son, Troy, O. Estimated cost $40,000.

Gypsum Factory — Structural Gypsum Corp., 53 Park Place, New York, N. Y., will build a 1 sory gypsum factory at Wood St. and Henley Ave., Linden, N. J. Estimated cost $250,000. Private plans.

Helium Plant—U. S. Government, Bureau of Mines, Washington, D. C., is having plans prepared for the construction of a helium plant near Amarillo, Tex. Estimated cost $500,000. H. Jones, Texas Representative, in charge.

Laboratory—American Gas Association, East 62nd St., Cleveland, O., awarded contract for a laboratory to De Hamel Construction Co., Plymouth Bldg., Cleveland, O. Estimated cost $100,000.

Laboratory — Maloney Memorial University of Pennsylvania, Philadelphia, Pa., is having plans prepared for an 8 story laboratory at 36th and Spruce Sts. Estimated cost $500,000. Tilden Register & Pepper, 1520 Locust St., Philadelphia, Pa., are architects.

Laboratory (Chemical)—Bowering Soap Co., Long Beach, Calif., plans the construction of a 4 story chemical laboratory and power house. Estimated cost $500,000. C. Provo Hubert, 1210 West 68th St., Los Angeles, Calif., is architect.

Laboratory (Pathological)—The University Hospitals Assn., F. A. Scott, Chn., c/o Warner & Swasey Co., 5701 Carnegie Ave., Cleveland, O., awarded contract for a 5 story, 57 x 160 ft. pathological laboratory on Abington Rd. to Crowell & Little Construction Co., Hanna Bldg., Cleveland, O. Estimated cost $750,000.

Laboratory (Testing)—Dominion Government, Ottawa, Ont., is having plans prepared for a new testing laboratory. Estimated cost $1,000,000. T. Fuller, Dept. Public Works, Ottawa, is architect.

Laboratories (Chemistry, Geology, Physics and Biology)—University of California, A. Underhill, Asst. Comptroller, 855 North Vermont Ave., Los Angeles, Calif., will soon award contract for a 3 story, 125 x 181 ft. chemistry and geology building and 3 story, 129 x 218 ft. physics and biology building near Westwood, Calif. Estimated cost $300,000 and $460,000 respectively. G. W. Kelham, Sharon Bldg., San Francisco, Calif., archt. former, and Allison & Allison, Hibernian Bldg., Los Angeles, Calif., archts. latter project.

Lacquer Factory—Richards & Co. Inc., 269 Ludlow St., Stamford, Conn., will build a group of buildings for lacquer factory including 2 story, 35 x 65 ft. beater house, 1 story, 45 x 85 ft. blender house, 2 story, 30 x 60 ft. extractor house, etc. Estimated cost $80,000. Work will be done under the supervision of J. W. Ferguson Co., 152 Market St., Paterson, N. J., Engrs.

Lead Concentrating Mill—St. Joseph Lead Co., Flat River, Mo., is having preliminary plans prepared for a lead concentrating mill, 1500 ton daily capacity at Mine La Motte, Mo.

Leather Tanning Factory—Barrett & Co., 49 Versey St., Newark, N. J., awarded contract for a 1 story, 25 x 100 ft. leather tanning factory at 40 Johnson St. to E. M. Waldron Inc., 27 Central Ave. Estimated cost $40,000.

Milk Products Plant—Texas Milk Products Co., c/o M. Turner, et al, Marshall, Tex., plans the construction of a plant for the manufacture of powdered milk and butter, 80,000 lbs. whole milk daily capacity. Estimated cost $150,000. Private plans. Machinery and equipment will be required.

Ovens, Furnaces, Etc.—Railway Board, Wellington, N. Z., will receive bids until Apr. 21 for four fuel oil forges, two fuel plate furnaces, two fired annealing ovens, two root blowers and six oil fired patent tilting furnaces.

Paint Factory—J. F. Kurfees Paint Co., 201 East Market St., Louisville, Ky., is having plans prepared for a 4 story, 62 x 204 ft. paint factory. Estimated cost $150,000. Joseph & Joseph, Francis Bldg., Louisville, Ky., are architects.

Paint and Varnish Factory—Cook Paint & Varnish Co., 450 Minnesota Ave., Kansas City, Mo., awarded contract for a 3 story, 60 x 100 ft. paint and varnish factory on Dana St., Cincinnati, O. to Collins Construction Co., Kansas City, Mo. Estimated cost $100,000.

Paper Factory—Consolidated Paper Co., Monroe, Mich., awarded contract for a 4 story, 115 x 400 ft. paper factory to Owen-Ames-Kimball Co., 38 Pearl St., Grand Rapids, Mich. Estimated cost $400,000.

Paper Mill—James J. Cumming, New Glasgow, N. S., plans the construction of a paper mill at Strait of Canso. Estimated cost $1,250,000.

Paper Mill—The A. P. W. Pulp & Paper Co. Ltd., Halifax, N. S., plans the construction of a pulp and paper mill. Estimated cost $750,000.

Paper Mill—Maryland Paper Mills Inc., Vermont Bldg., Washington, D. C., awarded contract for first unit of paper mill, 150 x 200 ft. at Glen Burnie, Md. to C. H. Brooks, Woodward Bldg., Washington, D. C.

Paper Mill—Charles R. McCormick Lumber Co., St. Helens, Ore., plans the construction of a paper mill on Columbia River. Estimated cost $3,000,000.

Pottery Plant—N. Clark & Sons, Pacific Ave. and Fourth St., Alameda, Calif., awarded contract for the construction of a pottery plant to A. T. Spence, 641 Taylor Ave., Alameda, Calif. Estimated cost $75,000.

Pottery Plant—Foster Pottery Co., Main St. W., Hamilton, Ont., had plans prepared for a 2 story, 50 x 100 ft. addition to pottery plant. Estimated cost $100,000. McPhie, Sun Life Bldg., Hamilton, Ont., is architect.

Pottery Plant—Woodbridge Ceramics Co., Green St., Woodbridge, N. J., plans the construction of a 2 story pottery plant. Estimated cost $200,000.

Pulp Mill—The West Lumber & Pulp Co., B. T. McBain, Gen. Mgr., Aberdeen, Wash., will soon receive bids for a pulp mill. Estimated cost $2,500,000.

Pulp and Paper Mill—A. B. Engle & Associates, representing T. C. Taylor Co., 550 Belmont St., Portland, Ore., will build a pulp and paper plant at Seattle, Wash. Estimated cost between $2,000,000 and $3,000,000.

Pulp and Paper Mill—Sacramento Pulp & Paper Co., 2712 21st St., Sacramento, Calif., is having preliminary plans prepared for a pulp and paper mill. Estimated cost $500,000. Private plans.

Pulp Paper Mill—Meade Pulp & Paper Co., Callahan Bldg., Dayton, O., E. L. McKee, Gen. Mgr., has acquired the controlling interest in the extract plant of the Parson Tanning Co. at Sylva, N. C., and plans a paper pulp mill, 100 ton daily capacity to make pulp from chestnut wood blocks after all extract has been obtained.

Refinery—Kilgallen Co., 6031 Wentworth Ave., Chicago, Ill., awarded contract for a 1 story, 70 x 132 ft. refinery at 6039 Wentworth Ave. Estimated cost $35,000.

Refinery (Copper)—Phelps-Dodge Corp., 99 John St., New York, N. Y., plans a copper refining plant in Ascarate Grant near El Paso, Tex. Estimated cost $3,000,000. Private plans.

Refinery (Oil)—Humble Oil & Refining Co., E. A. Bynum, Supt., Corpus Christi, Tex., will build a 10,000 bbl. oil refinery by day labor. Estimated cost $125,000. B. S. Love, Corpus Christi, Tex., is engineer.

Rubber Factory—Firestone Fire & Rubber Co., South Main St., Akron, O., awarded contract for first unit of rubber factory, 380 x 425 ft. at Los Angeles, Calif. Estimated cost $700,000.

Rubber Factory — Philadelphia Rubber Co., Oaks, Pa., awarded contract for a 1 story, 50 x 100 ft. addition to rubber factory to Robert E. Lamb Co., 849 North 19th St., Philadelphia.

Rubber Parts Factory—Michigan Rubber Co., c/o Zimmerman Mfg. Co., Owosso, Mich., had plans prepared for a 1 and 2 story, 50 x 150 ft. rubber parts factory, also remodeling present building on South Cedar St. Estimated cost $50,000. Private plans. Molds and heavy machinery for the manufacture of small rubber parts will be required.

Salt Factory—Canadian Salt Co., G. M. Duck, Mgr., Windsor, Ont., plans the construction of a factory for the manufacture of salt, caustic soda, washing powders, muriatic acid, etc. on Sandwich St. Estimated cost $300,000. Equipment will be required.

Sandpaper Plant—Minnesota Mining & Mfg. Co., E. B. Ober, Pres., St. Paul, Minn., awarded contract for a 2 story, 152 x 577 ft. sandpaper plant at Forest Ave. and Frauquier St. Estimated cost $250,000.

Smelter and Sulphuric Acid Plant—American Zinc, Lead & Smelting Co., W. F. Rossman, V. Pres., 1004 Pierce Bldg., St. Louis, Mo., is having preliminary plans prepared for aditions and improvements to smelter and sulphuric acid plant at East St. Louis, Ill., also zinc and oxide plant at Columbus, O.

Sugar Refinery—Imperial Sugar Refineries, Chamber of Commerce Bldg., Sarnia, Ont., plans the construction of a sugar refinery on River Front. Estimated cost $1,000,000. Architect not selected. W. E. Harris, c/o owner, is interested.

Soap Factory—Lever Bros. Co., 164 Broadway, Cambridge, Mass., awarded contract for the construction of a soap factory at Broadway and Harvard St. to F. L. Fox Inc., 101 Milk St., Boston, Mass.

Sulphur Plant—Gulf Sulphur Co., 41 East 42nd St., New York, N. Y., plans expansion of present sulphur plant, also increasing machinery units, etc. at Boling (mail Iago) Tex. Estimated cost $2,000,000. J. A. White Engineering Corp., 43 Exchange Pl., New York, N. Y., is engineer.

Tallow Plant — Western Tallow Co., Davidson and Lane Sts., San Francisco, Calif., plans to rebuild tallow plant recently destroyed by fire. Estimated cost $50,000.

Terra Cotta Plant—New Jersey Terra Cotta Co., 2 Catharine St., Perth Amboy, N. J., plans to rebuild 1 story, 65 x 150 ft. terra cotta plant to replace fire loss. Estimated cost $60,000. Private plans. Work will be done by separate contracts.

Tunnel Kiln—A. P. Green Fire Brick Co., Mexico, Mo., awarded contract for a tunnel kiln for brick plant to C. B. Harrop Co., 310 West Broad St., Columbus, O. Estimated cost $250,000.

Varnish Factory Addition—Hotopp Varnish Co., First St., Hoboken, N. J., awarded contract for a 3 story, 25 x 50 ft. addition to varnish factory on Marshall St. to Charles A. Vezzetti Inc., 40 Newark St., Hoboken, N. J. Estimated cost $40,000.

Varnish Factory Addition — Cleveland Varnish Co., 3111 East 81st St., Cleveland, O., awarded contract for a 1 story, 36 x 90 ft. addition to varnish factory to Albert M. Highley Co., Plymouth Bldg., Cleveland, O. Estimated cost $40,000.

Yeast Factory—Fleischman Co. of California, 947 South Maple Ave., Los Angeles, Calif., plans the construction of a yeast factory at Main and 48th Sts. Estimated cost $100,000. Private plans.

Technical Societies, Trade Associations and Commercial Organizations

AGRICULTURAL Insecticide & Fungicide Manufacturers Assn., Sec., G. B. Heckel, 1004 Public Ledger Bldg., Philadelphia, Pa.

Amer. Assn. for the Advancement of Science. Sec., Dr. Burton E. Livingston, Smithsonian Inst. Bldg., Washington, D. C.

Amer. Assn. of Cereal Chemists, Sec., R. K. Durham, 605 Huntzinger Bldg., Kansas City, Mo.

Amer. Assn. of Engrs. Sec., M. E. McIver, 63 East Adams St., Chicago, Ill.

Amer. Assn. of Flint and Lime Glass Mfrs. Actuary, John Kunzler, House Bldg., Pittsburgh, Pa.

Amer. Assn. of Ice & Refrigeration, Gen. Sec., J. F. Nickerson, 5707 West Lake St., Chicago, Ill.

Amer. Assn. of Textile Chemists & Colorists. Sec., Walter E. Hadley, 5 Mountain Ave., Maplewood, N. J.

Amer. Baker Assn. Sec., Dr. L. A. Rumsey, 1135 Fullerton Ave., Chicago, Ill.

Amer. Ceramic Society. Sec., Ross C. Purdy, Lord Hall, 2525 N. High St., Columbus, Ohio.

Amer. Chemical Society. Sec., Dr. Charles L. Parsons, Mills Bldg., Washington, D. C.

Amer. Concrete Institute. Sec., Harvey Whipple, 2970 W. Grand Blvd., Detroit, Mich.

Amer. Electrochemical Soc. Sec., Dr. C. G. Fink, Columbia Univ., New York.

Amer. Electro-Platers' Soc. Sec., Geo. Gehling, 5001 Edmund St., Philadelphia, Pa.

Amer. Engineering Council. Sec., L. W. Wallace, 26 Jackson Pl., Washington, D. C.

Amer. Engineering Standards Committee. Sec., P. G. Agnew, 29 W. 39th St., New York.

Amer. Foundrymen's Assn. Sec., C. E. Hoyt, 140 South Dearborn St., Chicago, Ill.

Amer. Gas Assn. Managing Director, Alexander Forward, 420 Lexington Ave., New York.

Amer. Gear Manufacturers Assn. Sec., T. W. Owen, 2443 Prospect Ave., Cleveland, Ohio.

Amer. Inst. of Baking. 1135 Fullerton Ave., Chicago, Ill.

Amer. Inst. of Chemical Engrs. Sec. H. C. Parmelee, Tenth Ave. at 36th St., New York, N. Y.

Amer. Inst. of Chemists. Sec., L. R. Seidell, 80 Washington St., New York.

Amer. Inst. of Consulting Engrs. Sec. & Treas., Philip W. Henry, 111 Broadway, New York.

Amer. Inst. of Electrical Engrs. National Sec., F. L. Hutchinson, 33 W. 39th St., New York.

Amer. Inst. of Fertilizer Chemists. Sec.-Treas., W. J. Gascoyne, Jr., 27 S. Gay St., Baltimore, Md.

Amer. Inst. of Mining & Metallurgical Engrs. Sec., H. Foster Bain, 29 W. 39th St., New York.

Amer. Inst. of Refrigeration. Gen. Sec., J. F. Nickerson, 5707 West Lake St., Chicago, Ill.

Amer. Iron & Steel Institute. Sec., E. A. S. Clarke, 75 West St., New York.

Amer. Leather Chemists Assn. Sec., H. C. Reed, 22 E. 16th St., New York.

Amer. Management Assn., Managing Director, W. J. Donald, 20 Vesey St., New York.

Amer. Manganese Producers Assn., Washington, D. C.

Amer. Manufacturers' Export Assn. Sec., R. G. Owens, 233 Broadway, New York.

Amer. Museum of Safety. Director. Albert A. Hopkins, Office, 141 E. 29th St.; Museum, 120 E. 28th St., New York.

American Oil Burner Assn. Managing Director, Leod D. Becker, 350 Madison Ave., New York, N. Y.

Amer. Oil Chemists' Society. Sec., J. C. P. Helm, 705 Tchoupitoulas St., New Orleans, La.

American Paint & Varnish Manufacturers' Assn., Inc. Sec., G. B. Heckel, 1002-4 Public Ledger Bldg., Philadelphia, Pa.; Gen. Mgr., George V. Horgan, 18 E. 41st St., New York; Director of Scientific Section, H. A. Gardner, 2201 New York Ave., N. W., Washington, D. C.

Amer. Paper & Pulp Assn. Exec. Sec., Dr. Hugh P. Baker, 18 East 41st St., New York.

Amer. Peat Soc. Acting Sec., J. H. Beattie, McLean, Va.

Amer. Petroleum Inst. Sec., R. L. Welch, 250 Park Ave., New York.

Amer. Physical Soc. Sec., Harold W. Webb, Columbia Univ., New York.

This compilation of technical and commercial organizations in the chemical engineering and related fields should prove valuable as a reference directory. An effort has been made in each case to give the name and address of the secretary or other responsible official. Additions or corrections should be sent to the Editor, *Chemical & Metallurgical Engineering*, Tenth Ave. at 36th St., New York City.

Amer. Pulp & Paper Mill Superintendents Assn. Sec., R. L. Eminger, 54 N. Main St., Miamisburg, O.

American Refractories Institute. Sec., Dorothy A. Texter, 2202 Oliver Bldg., Pittsburgh, Pa.

Amer. Society of Bakery Engrs. Sec., Victor E. Marx, 1135 Fullerton Ave., Chicago, Ill.

Amer. Society of Civil Engrs. Sec., George T. Seabury, 33 W. 39th St., New York.

Amer. Soc. of Heating & Ventilating Engrs. Sec., A. V. Hutchinson, 29 W. 39th St., New York.

Amer. Soc. of Mechanical Engrs. Sec., Calvin W. Rice, 29 W. 39th St., New York.

Amer. Soc. of Refrigerating Engrs. Sec., William H. Ross, 37 West 39th St., New York.

Amer. Soc. of Safety Engrs. Sec., W. D. Keefer, 108 E. Ohio St., Chicago, Ill.

Amer. Soc. for Steel Treating. Sec., W. H. Eisenman, 4600 Prospect Ave., Cleveland, Ohio.

Amer. Soc. for Testing Materials. Sec.-Treas., C. L. Warwick, 1315 Spruce St., Philadelphia, Pa.

American Soda Pulp Export Assn. Exec. Officer, Gibson Paine, 200 5th Ave., New York.

Amer. Welding Soc. Sec., Miss M. M. Kelly, 33 W. 39th St., New York.

Amer. Wood-Preservers' Assn. Sec., E. J. Stocking, 111 W. Washington St., Chicago, Ill.

Amer. Zinc Inst., Inc. Sec., Stephen S. Tuthill, 27 Cedar St., New York.

Asphalt Assn. Gen. Mgr., J. E. Pennybacker, 441 Lexington Ave., New York.

Associated Cooperage Industries of Amer. Sec. and Mgr., C. G. Hirt, B-20 Railway Exchange Bldg., St. Louis, Mo.

Associated Corn Products Manufacturers. Sec., Jay Chapin, 208 So. La Salle St., Chicago, Ill.

Associated Tile Mfrs. Sec., M. A. Illing, 420 Lexington Ave., New York.

Assn. of British Chemical Mfrs. Gen.-Mgr. & Sec., W. J. U. Woolcock, 166 Piccadilly, London, W. 1, England.

Assn. of Official Agricultural Chemists. Sec., W. W. Skinner, Box 290 Pennsylvania Ave. Station, Washington, D. C.

Australian Chemical Institute. Gen. Sec., Thos. Cooksey, 5 Elizabeth St., Sydney, N. S. W., Australia.

BISCUIT & Cracker Mfrs. Assn. Sec., R. T. Stokes, 90 West Broadway, New York.

British Assn. for the Advancement of Science. Sec., O. J. R. Howarth, Burlington House, Piccadilly, London, W. 1, England.

British Cast Iron Research Assn. Director and Sec., J. G. Pearce, 24, St. Paul's Square, Birmingham, England.

British Non-Ferrous Metals Research Assn. Director and Sec., Dr. R. S. Hutton, Athenæum Chambers, 71, Temple Row, Birmingham, England.

Bureau of Raw Materials for American Vegetable Oils & Fats Industries. Sec., John B. Gordon, 944 Munsey Bldg., Washington, D. C.

CANADIAN Engineering Standards Assn. Sec., B. Stuart McKenzie, Room 303, Bryson Bldg., 178 Queen St., Ottawa, Ont., Canada.

Canadian Inst. of Chemistry. Sec., L. E. Westman, 40 Richmond St., W., Toronto 2, Ont., Canada.

Canadian Inst. of Mining & Metallurgy. Sec., G. C. Mackenzie, 604 Drummond Bldg., 511 St. Catherine St., W., Montreal, Canada.

Canadian National Clay Products Assn. Sec., Gordon C. Keith, 49 Turner Road, Toronto 10, Ont., Canada.

Canadian Pulp & Paper Assn. Sec., Edward Beck, Room 701, Drummond Bldg., 511 St. Catherine St., W., Montreal, Que., Canada.

Canadian Society of Forest Engrs. Sec., A. H. Richardson, Parliament Buildings, Toronto 5, Ont., Canada.

Ceramic Society. Sec., Dr. J. W. Mellor, North Staffordshire Technical College, Stoke-on-Trent, England.

Cercle de la Chimie. Sec., René Dage, 54 Rue de Turbigo, Paris, France.

Chemical, Metallurgical & Mining Society of South Africa, Inc. Sec., H. A. G. Jeffreys, Scientific & Technical Club, 100 Fox St., Johannesburg, Transvaal, South Africa.

Chemists' Club. Sec. Robert T. Baldwin, 52 E. 41st St., New York.

Chilean Nitrate of Soda Educational Bureau, 57 William St., New York.

Chlorine, Institute, Inc., The, Sec., Robert T. Baldwin, 30 East 42nd St., New York.

Circle of Scientific, Technical & Trade Journalists. Hon. Sec., Leon Gaster, 32 Victoria St., Westminster, London, S. W. 1, England.

Clay Products Assn. Sec. and Consulting Engineer, George C. D. Lenth, 133 West Washington St., Chicago, Ill.

Common Brick Mfrs. Assn. of Amer. Sec., Ralph P. Stoddard, 2121 Guarantee Title Bldg., Cleveland, Ohio.

Compressed Air Society. Sec., C. H. Rohrbach, Room 1506, 90 West St., New York.

Compressed Gas Mfrs. Assn. Sec.-Treas., Franklin R. Fetherston, 120 W. 42nd St., New York.

Copper & Brass Research Assn. Sec., Harry H. R. Spofford, Mgr., W. A. Willis, 25 Broadway, New York.

Cost Assn. of the Paper Industry. Sec.-Treas., Thomas J. Burke, 18 East 41st St., New York.

Deutsche Chem. Ges. Sec., Dr. H. Jost, Sigismundstr. 4, Berlin, W. 10, Germany.

EASTERN Clay Products Assn. Sec., H. T. Shelley, 906 Colonial Trust Bldg., Philadelphia, Pa.

Edible Gelatin Manufacturers Research Society of America, Inc. Sec., H. B. Sweatt, 1457 Broadway, New York.

Enameled Sanitary Ware Mfgrs. Assn. Sec., George D. McIlvaine, 909 Oliver Bldg., Pittsburgh, Pa.

Engineering Foundation. Director, Alfred D. Flinn, 29 W. 39th St., New York.

Engineering Inst. of Canada. Sec., R. J. Durley, 2050 Mansfield St., Montreal, Que., Canada.

FARADAY Society. Sec., G. S. W. Marlow, 13 South Square, Gray's Inn, London, W. C. 1, England.

Franklin Inst. of the State of Pa. Sec., Howard McClenahan, 15 South 7th St., Philadelphia, Pa.

GAS Products Assn. Sec. and Treas., Stuart Plumley, 140 South Dearborn St., Chicago, Ill.

Glass Container Assn. Sec., R. E. Walker, 22 East 75th St., New York.

Gypsum Industries. Sec.-Treas., H. H. Macdonald, 844 Rush St., Chicago, Ill.

Hawaiian Sugar Planters' Assn., Director of Experiment Station, H. P. Agee, P. O. Box 411, Honolulu, Hawaii.

Hydraulic Society, The., C. H. Rohrbach, Room 1506, 90 West St., New York, N. Y.

ILLUMINATING Engineering Society. Gen. Sec., L. H. Graves, 29 W. 39th St., New York.

Industrial Alcohol Manufacturers Assn., Inc. Exec. Sec., Dr. Lewis H. Marks, 30 E. 42nd St., New York.

Insecticide & Disinfectant Mfrs. Assn., Inc. Sec., H. W. Cole, P. O. Box 473, Holbrook, Mass.

Institute of Amer. Meat Packers. Exec. Vice-Pres., W. W. Woods, 509 S. Wabash Ave., Chicago, Ill.

Institute of Makers of Explosives. Sec., C. Stewart Comeaux, 103 Park Ave., New York.

Institute of Margarine Manufacturers. Sec., Dr. J. S. Abbott, 1049 Munsey Bldg., Washington, D. C.

Institute of Metals. Sec., G. Shaw Scott, 36 Victoria St., Westminster, London, S. W. 1, England.

Institute of Radio Engineers. Sec., Dr. Alfred N. Goldsmith, 37 West 39th St., New York.

Institution of Chemical Engineers. Sec., Prof. J. W. Hinchley, Abbey House, Westminster, London, S. W. 1, England.

Institution of Mining & Metallurgy, Sec., Charles McDermid, Cleveland House, 225 City Road, London, E. C. 1, England.

Institution of Petroleum Technologists. Sec., Commander R. E. Stokes-Rees, Aldine House, Bedford St., Strand, London, W. C. 2, England.

Instituto Cientifico e Industrial del Salitre. Gen. Sec., Belisario Diaz Ossa. Casilla 2730, Santiago, Chile.

International Acetylene Assn. Sec., A. Cressy Morrison, 30 E. 42nd St., New York.

International Society of Leather Trades' Chemists. W. R. Atkin, University, Leeds, England.

Iron & Steel Institute. Sec., G. C. Lloyd, 28 Victoria St., London, S. W. 1, England.

Junior Institution of Engineers. Sec., Herbert G. Riddle, 39 Victoria St., Westminster, S. W. 1, England.

MANUFACTURING Chemists Assoc. of the U. S. Sec., J. I. Tierney, 921 Woodward Bldg., Washington, D. C.

Metric Assn. Sec., Howard Richards, 156 5th Ave., New York.

Mining & Metallurgical Soc. of Amer. Sec., Percy E. Barbour, 2 Rector St., New York.

NATIONAL Academy of Sciences. Sec., Dr. David White, National Academy of Sciences, 21st and B. Sts., Washington, D. C.

National Assn. of Cost Accountants. Sec., Stuart C. McLeod, 26 West 44th St., New York.

National Assn. of Cotton Mfrs. Sec., Russell T. Fisher, 80 Federal St., Boston, Mass.

National Assn. of Glue Mfrs. Inc. Sec., H. B. Sweatt, 1457 Broadway, New York.

National Association of Importers of Hides & Skins, Inc. Exec. Sec., Eugenia R. Arnold, 100 Gold Street, New York.

National Assn. of Leather Belting Mfrs. Sec., George H. Blake, P. O. Box 859, City Hall Sta., New York.

National Assn. of Mfrs. of Pressed & Blown Glassware. Sec., John Kunzler, House Bldg., Pittsburgh, Pa.

National Assn. of Mfrs. Sec., George S. Boudinot, 50 Church St., New York.

National Assn. of Practical Refrigerating Engrs. Sec., E. H. Fox, 5707 West Lake St., Chicago, Ill.

National Assn. of Purchasing Agents. Sec.-Treas., W. L. Chandler, 11 Park Place, New York.

National Assn. of Sheet & Tin Plate Mfrs. Sec.-Treas., Walter W. Lower, 421 Oliver Bldg., Pittsburgh, Pa.

National Assn. of Stearic Acid Mfgrs. Sec.-Treas., F. F. Jordan, c/o Emery Candle Co., Cincinnati, Ohio.

National Assn. of Textile Dyers & Finishers. Exec. Sec., Frederic L. Babcock, 465 Main St., Cambridge, Mass.

National Brick Manufacturers' Assn. Sec., Douglas F. Stevens, Acme Brick Co., Danville, Ill.

National Canners' Assn. Sec., Frank E. Gorrell, 1739 H Street, N.W., Washington, D. C.

National Clay Products Industries Assn., Commissioner, H. A. Jung, 133 W. Washington St., Chicago, Ill.

National Coal Assn. Exec. Sec., H. L. Gandy, 803-13, Southern Bldg., Washington, D. C.

National Conference of Business Paper Editors. Sec., A. J. Fehrenbach, Class, 8 W. 40th St., New York.

National Elec. Light Assn. Managing Director, Paul S. Clapp, 29 W. 39th St., New York.

National Fertilizer Assn. Exec. Sec., Charles J. Brand, 616 Investment Bldg., Washington, D. C.

National Fire Protection Assn. Sec., Franklin H. Wentworth, 40 Central St., Boston, Mass.

National Foreign Trade Council. Sec., O. K. Davis, 1 Hanover Sq., New York.

National Industrial Conference Board Inc. Sec., James M. Robertson, 247 Park Ave., New York.

National Industrial Council. Sec., Michael J. Hickey, 50 Church St., New York.

National Lime Assn. Gen. Mgr., G. B. Arthur, 927 15th St., N. W., Washington, D. C.

National Lumber Manufacturers Assn. Sec. & Mgr., Wilson Compton, Transportation Bldg., Washington, D. C.

National Metal Trades Assn. Sec., J. E. Nyhan, 122 So. Michigan Ave., Chicago, Ill.

National Paint, Oil & Varnish Assn. Inc. Gen. Mgr., G. V. Horgan, 18 East 41st St., New York.

National Paving Brick Mfrs. Assn. Sec., E. L. Beller, 332 South Michigan Ave., Chicago, Ill.

National Petroleum Assn. General Counsel, Mr. Fayette B. Dow, 930 Munsey Bldg., Washington, D. C.

National Pipe & Supplies Assn. Sec., Geo. D. McIlvaine, 908 Oliver Bldg., Pittsburgh, Pa.

National Research Council. Sec., Dr. Vernon Kellogg, B and 21st Sts., Washington, D. C.

National Safety Council. Sec., W. H. Cameron, 108 East Ohio St., Chicago, Ill.

National Wood Chemical Assn. Sec.-Treas., F. J. Goodfellow, 76 Main St., Bradford, Pa.

New Jersey Chemical Society. Corresponding Sec., Dr. Frederick W. Zons, 52 E. 41st St., New York, N. Y.

New Jersey Clay Workers Assn. Sec., G. H. Brown, Ceramics Dept., Rutgers College, New Brunswick, N. J.

New York Academy of Sciences. Sec., Dr. Roy Waldo Miner, 77th St. and Central Park West, New York City.

Oil & Colour Chemists' Assn. Sec., James H. Aiken, 30 Russell Sq., London, W. C. 1, England.

PINE Institute of America, Inc. Sec.-Mgr., Carl F. Speh, Barnett National Bank Bldg., Jacksonville, Florida.

Plate Glass Mfrs. of Amer. Sec., P. A. Hughes, First National Bank Bldg., Pittsburgh, Pa.

Portland Cement Assn. Sec.-Gen. Mgr., William M. Kinney, 33 W. Grand Ave., Chicago, Ill.

Pyroxylin Plastics Manufacturers' Assn. Sec., Ralph R. Lounsbury, 350 Madison Ave., New York.

Rubber Assn. of America. A. L. Viles, Gen. Mgr. and Sec., 250 West 57th St., New York.

Rubber Growers' Assn., Inc. Frank G. Smith, Sec., 2, 3 and 4, Idol Lane, Eastcheap, London, E. C. 3, England.

SALESMEN'S Assn. of the American Chemical industry. Sec.-Treas., A. L. Benkert, c/o Noil Chemical & Color Works, 140 West 108th St., New York.

Salt Producers Assn. Sec., D. B. Doremus, 7310 Woodward Ave., Detroit, Mich.

Sandlime Brick Assn. Sec., Miss Ellen Knight, c/o Jackson & Church Co., Saginaw, Mich.

Scientific Apparatus Makers of America. Sec., J. M. Roberts, 460 E. Ohio St., Chicago, Ill.

Société de Chimie Industrielle. Sec., Jean Gerard, 49 Rue des Mathurins, Paris, France.

Society of Chemical Industry. Sec., Dr. J. P. Longstaff, 46 Finsbury Sq., London, E. C. 2, England.

Society of Chemical Industry (American Section). Sec., Foster D. Snell, Pratt Institute, Brooklyn, N. Y.

Society of Dyers & Colourists. Sec., J. B. Atkinson, Pearl Assurance Bldgs., Market St., Bradford, England.

Society of Glass Technology. Sec., Prof. W. E. S. Turner, Darnall Road, Sheffield, England.

Society of Industrial Engrs. Exec. Sec., George C. Dent, 608 S. Dearborn St., Chicago, Ill.

Society for the Promotion of Engineering Education. Sec., Dr. F. L. Bishop, University of Pittsburgh, Pittsburgh, Pa.

South African Chemical Institute. Hon. Sec., James Gray Scientific & Technical Club, 100 Fox St., Johannesburg, So. Africa.

South African Institution of Engrs., Inc. Sec., W. W. R. Jago, Box 4609, Johannesburg, So. Africa.

Steel Barrel Mfrs. Institute. Sec., D. S. Hunter, 809 Bulkley Bldg., Cleveland, Ohio.

Sugar Producers' Conference. Sec., E. W. Mayo, 135 Front St., New York.

Synthetic Organic Chem. Mfrs. Assn. of the U. S. President, Dr. August Merz, Room 257, 1 Madison Ave., New York.

TANNERS' Council. Ass't Sec., J. L. Nelson, 41 Park Row, New York.

Taylor Society. Managing Director, Harlow S. Person, 29 W. 39th St., New York.

Technical Assn. of the Pulp & Paper Industry. Sec., R. G. Macdonald, 18 E. 41st St., New York.

Technical Publicity Assn., 23 Park Ave., New York; Sec., Louis J. Galbreath, American Brown Boveri Electric Corp., Graybar Bldg., 42nd St., New York, N. Y.

Textile Alliance Inc. Pres., A. M. Patterson, 45 E. 17th St., New York.

UNION Internationale de la Chimie Pure et Applique. Sec., Jean Gerard, 49 Rue des Mathurins, Paris, France.

United Engineering Society. Sec., Alfred D. Flinn, 29 W. 39th St., New York.

United States Alkali Export Assn., Inc. Sec.-Treas., H. M. Hooker, 25 Pine St., New York.

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U. S. Potters Assn. Sec., Charles F. Goodwin, East Liverpool, Ohio.

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